# BULLETIN

OF THE

# NATURAL HISTORY SOCIETY

OF

# NEW BRUNSWICK.

No. XXII.

VOLUME V. PART II.

PUBLISHED BY THE SOCIETY.

SAINT JOHN, N. B., CANADA:
BARNES & CO., PRINTERS, 84 PRINCE WILLIAM STREET.
1904.

## CONTENTS.

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PLATE III.

## ARTICLE I.

# NEW BRUNSWICK CAVES.

By L. W. Bailey, LL. D., F. R. S. C.

(Read December 1st, 1903.*)

The literature of New Brunswick, scientific or otherwise, contains but few references to caves as occurring within its borders, a circumstance from which the inference might naturally be drawn that they do not exist. Nor is the geological structure of the country very favorable to their development; for while considerable areas are occupied by limestones, the material in which caverns in other parts of the world are most extensively developed, and the Province possesses an extended coast line open to the undermining action of the sea, the limestones lack that horizontality which is almost as important as their chemical nature in the determination of extensive underground water-courses, while a considerable portion of the coast is composed of metamorphic rocks, which are not only highly tilted, but of such a nature as to be but little affected by the attacks made upon them. As a matter of fact, therefore, the Province does not contain any caves or caverns at all comparable with those met with in some other countries. Yet we are not wholly without subterranean cavities, and some of these are by no means devoid of interest. It is the purpose of this paper to bring together, as is being done by Dr. Ganong in relation to other physiographic features of the Province, such authentic facts relating to this subject as the writer has been able to obtain.

### Sea Caves.

Two sides of New Brunswick front the sea, one, the southern, fronting the Bay of Fundy, being about 250 miles in length, while

*Read previously before the Fredericton Natural History Society.

the other, commonly known as the North Shore, facing the Gulf of St. Lawrence, is in the form of a crescentic curve, which is somewhat longer. On the north the border is also a water one, that of the Bay Chaleur and Restigouche river, but is of minor importance in the present connection. The total coast line is about 600 miles in length.

On the southern coast the shore is bold, the water deep, and the action of waves, tides and currents powerful. But as a rule the rocks forming this coast are either compact and crystalline, giving to these agencies but little chance to act, or they are composed of schists dipping at high angles towards the sea and forming steeply sloping walls, from which the waves are turned back with little excavating effect. Hence, though the coast line is somewhat broken, and in places picturesque, it seldom shows much undermining, or the formation of any recesses, which can fairly be designated as caverns. An exception to this general statement is, however, to be found along certain portions of the shore, where the old pre-Cambrian schists have still resting upon them, or sloping off from them, strata of more recent age. This is to some extent true along the shores of Lepreau Basin and about Point Lepreau, and again in the vicinity of Quaco, especially about Melvin's beach, both localities being in rocks of the Lower Carboniferous system; but the most remarkable illustrations by far are those which occur in connection with the rocks of the same formation about the head of the Bay of Fundy, at Hopewell Cape. Here a series of coarse conglomerates, dipping landward at a high angle, and broken by numerous faults, skirt the shore for half a mile or more, in a series of bluffs one hundred feet or more in height, and owing partly to their exposed position, just where the accumulated energies of the bay have their maximum of power, and partly to their own nature (the loosened pebbles of the rock adding enormously to the eroding action of the water), have been carved and undermined to a degree not often equalled. Certainly no point on the Atlantic seaboard of America can show more curious or more impressive exhibitions of sea-sculpture than are to be found here. The accompanying

PLATE IV.

NATURAL ARCH IN SANDSTONE AT MIRAMICHI.

illustration will convey some idea of their character, though not exhibiting special features of caves. (See frontispiece). Of these, some are evidently the result of simple undermining; others are apparently due to the displacement and fall of large sections of rock now found piled against the more solid face-wall, but with considerable irregular empty spaces between; while in still other instances it is possible to work one's way for several hundred yards through passages shut in by rock on either side, and dark, except where at times some open space, a hundred feet or more above one's head, admits a feeble light to guide the steps. At high water and during storms the waves must be driven with great force through some of these passages, and it is probable that "spouting horns" are sometimes found, though none of these have as yet been reported.

Another tract in which sea-sculpture has produced somewhat, similar results, though upon a scale of much less grandeur, is that of Miramichi Bay. Here the rocks are the grey sandstones and grits of the coal formation, and their attitude is horizontal, conditions which have elsewhere shown themselves to be favorable to cave-production; and it is no uncommon thing along the coast to find localities exhibiting overhung recesses, some of which are quite noteworthy. At times also here, as on the Bay of Fundy shore, the partial falling in of roofs of cavities, or it may be the battering action of the waves on either side of narrow promontories, has determined the formation of arches or natural bridges. One of these, occurring on Miramichi Bay, some fifteen miles from Chatham, is shown in an accompanying plate.

## River Caves.

Under this designation may be included the cave-like excavations found in such proximity to surface streams as to indicate that they, in part at least, owe their origin to the action of the latter. Here, again, the most numerous and marked examples of such wear are to be found in connection with the coarse sandstones and grits of the coal formation. Thus on the Miramichi

river, between Chatham and Bushville, are several places in which the bordering vertical banks of rock have been carved out into cave-like forms; but the most remarkable instances of such excavation, apparently, are some to be found upon the northwest branch of this stream. Of one of these the late M. H. Perley gave the following account in a letter to the N. B. *Gleaner,* October 4, 1845, and for a copy of which I am indebted to Prof. Ganong. He says:

"While at the Indian Reserve, near the Big Hole on the North West, I lived in a very curious and romantic cave, which has been known to the Indians for centuries, but of which I never heard until I was shown into it. The Micmacs call the place "*Condeau-weegan*"—the "Stone Wigwam." Its only entrance is from the water, under a lofty overhanging cliff. The floor of the cave is (by measurement) ten feet above the level of the water, the height of the uppermost overhanging ledge is seventeen feet above the floor of the cave; and the width of the entrance seventy feet. Above the side of the cave a clear and very cold spring bubbles up continually, and an aperture in the roof (whether natural or artificial, I cannot say,) permits the smoke to escape freely. The rocks at this place are all sandstones of coarse grit, thickly studded with angular pebbles of milky and rose-colored quartz, and the exceeding abundance of these crystals give the place the appearance of an artificial grotto. The river rushes swiftly past the entrance, standing in which some very fine trout were caught. The Indians spear many salmon at this place, and they have hollowed out a basin at the spring, in which they place the salmon. The coldness of the water keeps them fresh for two or three days."

The above account is so circumstantial, including definite measurements, that one hesitates not to accept it in its entirety; but considering the fact that the locality has been for years a well known and favorite fishing ground, it seems strange that there should exist at the present time so much uncertainty regarding it. Thus in connection with some enquiries made by me of

the late Col. Robert Call, Sheriff of Northumberland county, the latter says that, although some thirty years ago he "went for fishing very often to the Big Hole, he did not remember of hearing anything about a cave" in that vicinity. He adds, however, that upon enquiry, he learned that there is a cave there, and that in it, it is said, a squaw gave birth to a child in the night of the great fire in October, 1825. Again Mr. George Brown, a resident of Chatham, and the present owner of the land and fishing privileges on the northwesterly side of the Big Hole, while saying to Col. Call that he knew where the cave is, and had been in it, felt confident, though without particular examination, that it was small compared with the description given by Perley, adding that he did not think it to be more than fifteen feet wide and six or seven feet in height, extending inwards quite a distance, and narrowing off to a point. Mr. Brown also says that he knows of another cave at the Square Forks of the Sevogle, about ten miles above the Big Hole, that the fishermen have converted into a smoke house, but this is much smaller than that at the Big Hole. Finally Dr. Nicholson, of Chatham, in a letter to Prof. Ganong, referring to the latter cave, says that it is known there, and that Perley's description is accurate.

## Caves Resulting from Subterranean Drainage.

In the case of all the excavations noticed above, the results have been due almost exclusively to mechanical action, the wear of waves, tides, or river currents, and only in rare instances are the holes shut out from the light of day. We may now consider some cases which are truly subterranean, and which owe their origination not wholly, or even principally, to mechanical wear, but largely to the *solvent* power of water.

The materials capable of being acted upon by water in the way of solution to an extent sufficient to produce noticeable cavities are limited to three or four, viz., salt, gypsum, limestone and dolomite.

Where beds of rock-salt occur, their removal, whether the result of natural or artificial agencies, necessarily tends to pro-

duce cavities corresponding to the material removed; but though saline springs are found at a number of places in New Brunswick (mainly in the Lower Carboniferous system of Kings county, as near Sussex and Salt Spring Brook), no actual beds of rock-salt are known to exist, and the land in their vicinity gives no indication of the existence of considerable cavities.

In the vicinity of gypsum beds the case is different. Large deposits of the latter occur near Hillsborough, in Albert county, in the parish of Upham, in King's county, and on the Tobique river, in Victoria county; and in each of these cases the district immediately surrounding the deposits is remarkable for the evidences of removal. These are usually in the form of pits or sink holes, though subterranean passages also exist. Near the plaster beds of Hillsborough the ground is honeycombed with these vertical holes, so closely aggregated in places and with such narrow intervening walls as to make passage across both difficult and dangerous.

Mr. C. J. Osman, M. P. P., manager of the Albert Manufacturing Company, informs me that he has seen them fully forty or fifty feet deep, while in places, where they are covered with surface deposits, they are sometimes very large, extending in diameter fully one hundred feet, with a depth of forty to fifty feet. He adds that the plaster lands are covered with such depressions, and they are, without question, the result of the percolation of water through seams and fissures in the rock. These waters are sometimes seen issuing as springs of considerable volume below bluffs of gypsum rock, but as a rule the outlets are on the surface of the lower lying lands at the foot of the plaster hills. Even here Mr. Osman has found evidence of subsidence in what might be taken to be the extreme low level for drainage, and showing that there are still deeper subterranean passages. At what is known as the "Sayre quarry," where a good deal of underground work has been done, Mr. Osman has found evidences of old water-courses, which, as he thinks, must be at least sixty or seventy feet below the original water level of the little lake which

is one of the peculiarities of that quarry; the water having been formerly discharged by outlets through the underlying limestone and thence to the bed of the river.

It is in connection with these gypsum deposits that the ice pits and the subterranean lake referred to by Prof. Ganong in Bulletin XXI occur, both of which have been visited by the writer, and in one of which he found several feet of snow in the latter part of July. Of the underground lake, so called, on Demoiselle creek, Mr. Osman has kindly furnished me with the following description:

"The gypsum deposit in which the depression occurs presents a high front, probably 90 or 100 feet high, of anhydrite, containing some seams of hydrous gypsum, to a very limited extent, and at the base of this wall of hard rock the little Demoiselle brook ripples peacefully along. At the back of this wall of anhydrite, more or less hydrous gypsum has been found, but not to any large extent, as immediately to the back of it red marl-like limestone and conglomerate has been exposed after limited operations; but a certain wash has taken place, or perhaps solution of the soft rock, which eventually resulted in finding an outlet for the water collected in the pocket so created through one of the seams of soft gypsum in the anhydrite wall, and eventually emptied into the Demoiselle brook, wearing away as it went more or less of the soft gypsum, and making this underground cavern probably about forty feet in width and about 200 feet in length. Without taking any levels, I think the level of the water running through this cavern is pretty nearly the same as the water in the brook, as at the point where it is deepest it is very still, although there is some current in it. Therefore, I surmise that the present source of this little basin of water is from up the brook, and that it flows in at the upper end and out to the brook again at the lower end.

"As near as I can estimate, it is perhaps fifty or sixty feet from the level of the plaster heads at the back of the hard face and down to the surface of the water in the little lake, and in

reaching it the climb from the level of the brook is about the same. The whole roof of the cavern is anhydrite, and very little soft gypsum has apparently been exposed by the action of the water. Heretofore its chief interest has been its picturesque surroundings. These have been more or less destroyed by cutting of trees, and permitting the earth dumps made in quarrying plaster to run down the slope near to the little lake."

The third material favoring removal by the combined mechanical and solvent action of water is limestone or dolomite. It is in rocks of this nature, as in Virginia and Kentucky, that the most extensive and remarkable caverns of the world are to be found. In New Brunswick, limestones and dolomites, intimately associated, form extensive deposits in St. John and Charlotte counties, and have been largely removed from the time of the first settlement of the country, while in other parts of the Province, limestones, usually less pure, are met with alike in the Silurian, Devonian and Lower Carboniferous systems. In each of these, but especially the latter, caves and subterranean passages are to be met with.

Of the caves connected with the Lower Carboniferous limestones, the most remarkable known to me are found about the tributaries of Hammond River, in Kings county. One of these was partially explored by the writer, many years ago, in company with the late Prof. C. F. Hart, but beyond the fact that we penetrated several hundred feet, I am unable now to recall anything definite. Another cave, in similar limestones, was also visited by us near the Coverdale river, in Albert county, and may be specially noticed as containing bones apparently of the deer or moose, the only relics of this kind, so far as known to the writer, thus found in New Brunswick. It may be that in this same formation occurs the cave referred to in the following letter from Dr. B. S. Thorne to Prof. Ganong:

"About one and a half miles from Havelock Corner there is a stream which runs underground for about one mile, and forms 'ice caves.' My son, Dr. Van B. Thorne, a number of years

ago, took a line and light and went in about 300 yards, and brought out a large lump of ice in July." He does not state the nature of the rock in which the excavation occurs.

In connection with the subject of caves in the Lower Carboniferous rocks, the mode of occurrence of the manganese deposits in Kings county, especially about Markhamville, is interesting and suggestive. Desiring some reliable data upon the subject, I applied to Col. Alfred Markham, former manager of the Markhamville manganese mines, and from him have learned the following particulars:

(1) "I have found caverns at Markhamville and at Dutch Valley, in King's county. Those explored by me were very irregular in size and shape. They had all more or less water running through them, some of them opening to the surface on the sides of ravines having small entrances and opening out into irregular chambers ten to fifty feet wide and six to twenty feet high, narrowing again into small passages, while some of them showed manganese in small irregular patches imbedded in the rock at sides, top and bottom."

(2) "Other caves were closed by earth from the outside, and were opened by my workmen in driving drifts into them in search of manganese."

(3 "I do not think that the deposits of manganese came by filling caves previously formed, because in most cases the rock surrounding pockets of manganese is impregnated with ore so intimately mixed that they must have been deposited at the same time. Yet, on the other hand, I have taken small nodules of high-class ore (pyrolusite) like taking a nut out of its shell."

(4) "I have not found any evidence to warrant the statement that manganese was deposited from an aqueous solution. I should add that the manganese oxide is not found exclusively in rock formation. I have taken hundreds of tons out of the alluvium, sometimes under more than ten feet of earth."

Regarding temperature in the caves, Col. Markham adds: "In some of the caves which I have examined, I have found ice

in the month of July, and one immediately in rear of my house at Markhamville, which is a narrow slit in the rock, into which a boy can crawl fifty feet or more, delivers a small stream of pure ice-cold water all the year round, the volume of which is not much affected by heavy rains. The hill above it rises probably 200 feet in 500 yards."

This is not the place in which to discuss at length the origin of manganese beds, but the observations of Col. Markham seem to point strongly to the conclusion that they are residual deposits, not conveyed to their present site by the action of solvent waters, thus filling up pre-existing caverns, but left in a concentrated condition by the removal, through solution, of the limestone beds originally containing them, a process similar to that by which large beds of ferriferous dolomite have in some parts of the world become replaced by extensive deposits of limonite.

I am not aware of the existence of any noticeable caves or cavities in the limestones of the Silurian system. The fact, however, observed at Grand Falls, that a stream of considerable volume discharges into the gorge from the face of the cliff, only a few yards below the face of the cataract, indicates that, where circumstances are favorable to their production, subterranean channels exist.

In the pre-Cambrian limestones and dolomites of St. John and Charlotte counties, cavities of small size have been frequently laid open in the course of quarrying operations. At other points indications of subterranean cavities are to be found in the hollow sound beneath the tread of the feet, or the fact, illustrated in some of the limestone hills about Brookville, that holes exist in which, if stones be introduced, these may be found, as indicated by the sound, to drop for considerable distance before striking bottom. Prof. Ganong informs me that, as a boy, he was acquainted with a good cave in the rear of Lily Lake, near St. John, the dimensions of which he cannot now recall. But probably the most interesting excavation occurring in these limestones is that of Oliver's cave, so-called on the Sandy Point road, about two miles from

St. John. It is evidently an old underground water course, now left dry by the drainage passing in another direction, and is of considerable size, but as it is fully described elsewhere in this Bulletin, it will not be necessary to further refer to it here.

In concluding this branch of the subject, a mere reference may be made to the pot-holes found in several of our rivers, especially in the vicinity of the falls, and which, though hardly falling under the designation of caves, are of related origin. By far the finest are to be seen in the gorge of the river below the Grand Falls of the St. John, where they are of all sizes, the largest attaining a depth of thirty feet, with a diameter of sixteen feet at the top, widening at the bottom. The latter is usually occupied by rounded pebbles of hard rocks, the whirling of which by the tumultuous waters has been the main agent in their formation. On the Nepisiguit river vertical pot-holes, large enough to conceal a man, are found below the Pabineau falls, where the rock is a hard granite. On the Pollet River, near Elgin, in Albert county, the Gordon Falls have below them numerous pot-holes in Lower Carboniferous conglomerate, and evidences of subterranean currents are very noticeable.

In none of the instances of cave-formation alluded to above has any reference been made to the occurrence of statactites. Nor are these known to occur. But at certain points along the border of the Tobique river, in Victoria county, are somewhat extensive deposits of loosely branching coralloidal or statactitic limestone, of Lower Carboniferous age, while the hollow sound produced by walking over them would indicate the existence of cavities beneath. In the same vicinity are remarkable examples of fossil tree trunks, evidently petrified by the agency of calcareous solutions.

## Caves or Cavities of Uncertain Origin.

Under this head I would include a number of instances in which caves or cave-like spaces occur, and which are not obviously due to the agencies heretofore described, and some of which cannot be thus explained.

Among these I may first refer to a series of so-called caves occurring along the course of Corbett's brook, a small tributary of the St. John river just below Fredericton. At the point where they occur the brook occupies a well-marked and narrow valley, both sides of which are somewhat abrupt, while that to the north is for a quarter of a mile, or more, bordered by a series of bluffs, which here and there show steep or nearly vertical masses of rocks. These are the grey sandstones and conglomerates of the coal formation, probably representing its lower member, the millstone grit. They are of course well stratified, and their attitude horizontal, a feature made conspicuous in places by the extent to which certain beds are made to project, sometimes as much as ten or fifteen feet from the general face of the rock wall. In other places large blocks of rock are confusedly piled against the same wall, as though they had been dislodged from the latter by some powerful agency. Thus a variety of cavernous spaces have been produced, now the abode of numerous porcupines, the excreta of which cover their floors. In one instance a cavity of this kind, having a small entrance, is sufficiently large within to accommodate not less than fifteen persons. Others are remarkable for their narrow cleft-like character and for their parallelism with the general face of the bluffs.

It might at first seem probable that the conditions above described would find a ready explanation in the wearing action of water, and would be comparable with those already described as due to this agency along the sea-coast. But apart from the fact that Corbett's brook is altogether too insignificant, at least in its present state, to determine much mechanical wear, it is to be noted that the site of the caves is removed several rods from the present course of the stream, besides being twenty or thirty feet above its level. The direction, also, of many of the rifts and cavities, running in for considerable distances from the face of the rock, and at right angles to the latter, is opposed to the view that running water alone has been concerned in their production. Finally it is to be noticed that at several places in the uplands

to the north of the brook, and in some instances several rods distant from the latter, the ground shows narrow vertical rents or rifts, similar in character and direction to those near the brook, from one to two feet in width, and of unknown depth, but certainly twenty feet or more. When seen by the writer, in early June, they were partially filled with snow.

Reviewing these facts, it would seem probable that the projection of rock-roofs and consequent formation of grottoes, or miniature caves, to which reference has been made, may best be explained as the result of rock decay in soft, easily disintegrated strata overlaid by more massive and enduring beds, the agency of disintegration being mainly that of frost. The same explanation would account for the resting of large blocks at various angles against the rock face, they being merely masses which have fallen as their support has been removed. But for the rift-like fissures, some other explanation is required, and none seems so probable as that they are due to differential movements and possibly to earthquake shocks. As to their time of origin, it would seem improbable that they are pre-Glacial, as otherwise they would naturally be completely filled with drift—a view which is strengthened by the overhanging projections above the caves, which, under the weight of a superincumbent heavy weight of ice, would certainly have been broken off.

As connected with this subject, it is interesting to notice the evidences elsewhere observed of differential movements in the rocks of the millstone grit formation, and of extensive underground drainage as associated with the latter. For not only do faults abound, but in connection with boring operations undertaken for the discovery of coal, evidence has repeatedly been found of cavities or fissures of considerable size many feet below the surface. Thus at Newcastle, Queens county, the diamond drill, at a depth between one hundred and two hundred feet, suddenly dropped several feet, and upon withdrawal was followed by a fountain of water, several feet high, which continued to play for many months, and similar phenomena have been observed

elsewhere. It has also been stated that in the vicinity of the Penniac stream, a branch of the Nashwaak, in York county, vertical holes in the Carboniferous sandstone exist of such a character as to permit of a man being lowered into them to a depth of fifty feet or more. In the Corbett's brook region, near Fredericton, but at a considerable distance from the caves described above, is a remarkable depression, the origin of which is problematical. It is said to be in the general shape of a square, with vertical rock walls or faces, each about fourteen feet wide and about fourteen feet deep. The bottom of the depression is filled with earth, on which small trees are growing.

In the fissured or cavernous-like character presented by the millstone grit formation of New Brunswick, this recalls that of the same formation in portions of Kentucky, Virginia and Tenessee, where similar holes abound in the escarpments of stream valleys, and are known as "rock-houses." There is no evidence of their having been employed in New Brunswick for human occupation, unless it be in the case of the big cave on the Northwest Miramichi already described.

I have been informed that in a deposit of apparently recent origin on the northern side of Swan Creek lake, in Sunbury county, there occur several curious holes. The bluff is about forty feet high, and is composed of a hard clay, filled with a great variety of pebbles. The holes run in horizontally at least eight or ten feet, the openings being about two feet wide. In front of these openings is a narrow ledge, or path. It is said that these holes are the homes of raccoons, and, by their appearance, they being quite round and smooth, it looks as if they had been actually hollowed out by these animals.

To the above notes may be added the following, kindly furnished by Prof. Ganong, and which may at least suggest points for further exploration:

*From Mr. W. E. S. Flewelling, Waterford, Kings Co.*

" A noted ice cave near the village of Waterford, where ice keeps all summer. Eight deep holes or bottomless pits two or three miles from village."

*From the Postmaster at Lynnfield, Charlotte Co., N. B.*

"Goat Brook is an underground stream for some distance."

*From George Draper, Postmaster, Campbell Settlement, York Co.*

"There is a place in Waterville that is very good limestone, and in one place there is a hole that if one throws a stone into it, they can hear it rattle down as if it went from one to two hundred feet." [The limestones of Waterville are Silurian limestones, containing remains of encrinites. The writer has examined them several times, but heard nothing of the hole referred to.]

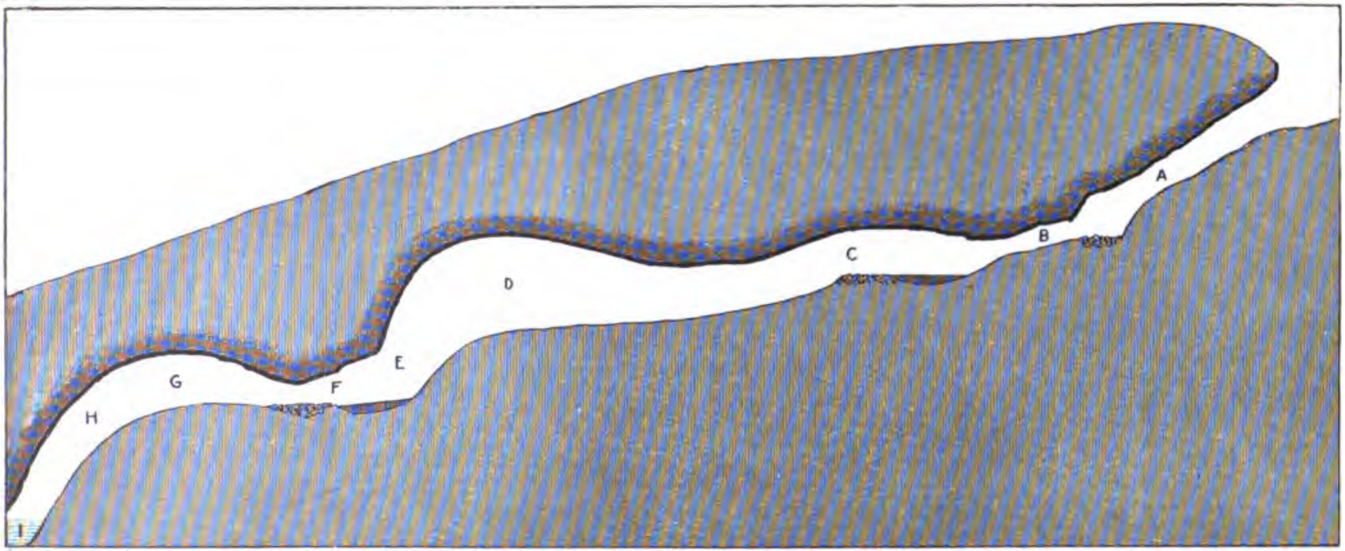
*From Mr. W. R. McMillan, Jacquet River, Gloucester Co.*

"There is supposed to be an underground lake or deep stream in Archibald Settlement. A number of years ago a man was digging a well, and at the depth of about eighteen feet the bottom fell out, leaving him standing on a ledge of rock. He tried a pole around, and could not reach any sides or bottom to the water. Two or three years ago, when boring for water on higher ground, about 300 yards away, a pond of water was struck at what was supposed to be the same level as the other."

*From Mrs. Noble Beatty, of French Village, Kings Co.*

"On the top of a mountain facing French Village there is a cave, locally known as 'Adam's Oven.' It can be entered by an opening on its side, and egress may be made by a somewhat similar opening in the top. About three miles from here, on Charles Darling's property, there is a very similar cave. It has a square entrance. The cave itself is very long, and has certainly been formed by nature."

PLATE V.




**SECTION OF OLIVER'S CAVE.**
Scale about 28 feet to an inch.

(A) Entrance slope.
(B) Passage to antechamber.
(C) Antechamber of main cave.
(D) Main chamber of cave.
(E) Small chamber at lower level.
(F) Low passage.
(G) Inner chamber.
(H) Slope to well.
(I) Well at end of cave, filled with water.

ARTICLE II.

# NOTE ON OLIVER'S CAVE.

BY G. F. MATTHEW, LL. D., F. R. S. C.

Somewhere in the "sixties" the finding of a cave on Howe's (now called Sandy Point) road was announced in St. John, the discovery having been made by a man named Oliver, living in the parish of Portland (now incorporated with St. John).

At that time the Natural History Society of New Brunswick was but recently formed, and two of its zealous young members, Messrs. I. Allen Jack and Robert Matthew, undertook to explore the cave. The former of these gentlemen is now dead, and the latter, still a life member of the Society, is in Cuba. Robert Matthew, or the two, collectively, wrote an article on the cave, which was deposited with the Society (but which cannot now be found). With this article he filed a section of the cave, a reduced copy of which is furnished with this note.

In later years the entrance of this cave has been blocked up, but as the writer of this note made a visit to it soon after its discovery in company with its first explorers, he is able to describe the section, and say something about the features of the cave.

## DESCRIPTION OF THE CAVE.

The entrance is in the form of a low arch, which may be noticed in the side of a low limestone ridge, that separates a shallow valley leading up to Dark lake, from the valley of Simond's brook, a small stream that discharges into the St. John river at Indiantown. This brook crosses the Sandy Point road a short distance below the site of the cave.

Descending into the cave from the entrance is a slope (A) large enough for a man to pass easily, and at the foot of the slope is a landing with a floor composed of fragments of rock that have fallen from the sides of the slope. Beyond this is a low passage (B) that gives access to an ante-chamber of the main cavern. This ante-chamber (C) has a flat floor, partly of loam and partly of rock-fragments, which have fallen from the roof of the cave.

The main chamber of the cave (D) is about sixty feet long and ten feet or more in height at the highest part. The floor of this chamber is not level, but slopes to the eastward and southward. This is the most interesting part of the cave, not only because of its size, but because of the bats which, when the cave was discovered, hung in large numbers suspended by their claws from the roof.* Another peculiarity of this chamber was the slender filaments of the roots of trees that hung from the crevices of the roof, and which were attributed to the trees which then grew in a thick wood on the limestone hill above the cave. The section prepared by Mr. Robert Matthew gives a thickness of from fifteen to twenty feet of limestone above this part of the cave, but I do not know whether the outline of the surface shown in the plan is from actual survey, or only approximated. In this chamber and elsewhere in this cave, we found stalactites and stalagmites, but these were not remarkable for their size or beauty. However, a number were collected and placed in the museum of the Society.

Beyond the main chamber is a short descent to a small chamber (E) at a lower level; the roof is hardly separated from the main chamber, and the floor is flat and covered with loam or clay. From this depressed level there extends a low and difficult passage (F), much obstructed by fragments of limestone that have fallen from the roof. Crawling through here one comes to a small inner chamber (G) that terminates in a sloping passage (H), somewhat similar to the entrance passage, but smaller and shorter.

*The species is *Vespertilio subulatus*, the Little Brown Bat.

The lower end of this sloping passage is filled with water (I), which bars any further progress in the cave. This sloping well of water was sounded with a pole, but no bottom was found. The water in the well was found to stand at the level of the alluvial deposit which fills the valley of Simond's brook at this point, and in the alluvium opposite the site of the cave is a weak spring, supposed to mark the discharge of the cave drainage.

Though there are several small passages leading out from the sides of the cave, none of these were large enough for exploration, and they seem to mark points where contributory streams may have entered the cave.

A partial examination was made of the loam which occurs at two points on the floor of the cave, for remains of man or of animal occupancy. Nothing was discovered to show that aboriginal man had ever used this cave for residence or sepulture. Nor does it seem to have been much resorted to by beasts of prey; some bones of a lamb were found, whose presence in the cave may have been due to this cause; and the thigh bone of a porcupine (*Hystrix dorsata*) was also met with. Had a skeleton of this animal been found, it would not have been surprising, as this creature is in the habit of resorting to caves and clefts of the rocks.

## Origin of the Cave.

The origin of this cave goes back to an early period of Geological history, since the topography of the neighborhood has been greatly changed since the cave was formed. The cave is evidently an old water passage, worn by a strong current. That it is an old water-course is specially shown by the tunnel and well at its lower end. But now, except for this well, the cave is quite dry, and no water from a distant source flows through it.

A shallow valley coming westward from the direction of Dark lake (a small pond a few hundred yards away) runs by the mouth of the cave, but this valley is also dry, and it is necessary to postulate a barrier in this valley west of the cave's mouth, to

turn into the cave any stream which might have come down this valley in former times.

That the cave is pre-Glacial in its origin is very evident since the outlet is now choked with Glacial deposits; how much older, it would be difficult to say; but at least this may be said, that the topography of the district where the cave is situated, has been greatly changed since the cave was formed.

## WINTER CURTAIN OF THE CAVE.

Occasionally in mid-winter a striking spectacle may be seen at the mouth of the cave. The warm air flowing out of the cave condenses its moisture on the roof in a deposit of hoar-frost, that in still weather hangs pendent like a curtain from the roof at the entrance. To see this canopy in all its beauty, one needs to go inside the sloping descent into the cave and look out through the entrance on a bright sunny afternoon; the western sun then lights up this curtain so that it becomes a mass of brilliant silver spangles, which, as the sun goes down, become varied with rainbow tints. Thus cold weather, still air and a western sun, give an added winter beauty to Oliver's cave.

The following are the lengths of different parts of the cave:*

| | | | |
|---|---|---|---|
| (A) | Slope at the entrance, .. .. .. .. .. .. .. .. .. .. .. .. | 32 | feet |
| | Landing at the bottom of the slope, .. .. .. .. .. .. .. | 8 | " |
| (B) | Passage to antechamber, .. .. .. .. .. .. .. .. .. .. .. | 16 | " |
| (C) | Antechamber of the main cavern (flat loam floor), .. .. | 24 | " |
| (D) | Main chamber of the cave, .. .. .. .. .. .. .. .. .. .. | 60 | " |
| (E) | Small chamber at a lower level with loam floor, .. .. .. | 16 | " |
| (F) | Low passage to inner chamber, .. .. .. .. .. .. .. .. .. | 12 | " |
| (G) | Inner chamber of cave, .. .. .. .. .. .. .. .. .. .. .. | 24 | " |
| (H) | Slope to the well at end of cave, .. .. .. .. .. .. .. | 20 | " |
| (I) | Well sloping southward, depth unknown, .. .. .. .. .. .. | | |
| | Measured length of cave, .. .. .. .. .. .. .. .. .. .. | 212 | " |

* These measurements are based on the plan of the cave made by Mr. Robert Matthew, which was on a scale of 8 feet to an inch.

ARTICLE III.

# UPON ABORIGINAL PICTOGRAPHS REPORTED FROM NEW BRUNSWICK.

BY W. F. GANONG.

Read October 6, 1903.

So far as I have been able to ascertain, there have been reported from New Brunswick only four aboriginal pictographs,* real or supposed, as follows:

(1) The pictures upon wood indicating a portage-path and a dangerous fall, described by Gesner in his *New Brunswick*, page 112. These have, of course, disappeared, and no others of the kind are known.

(2) The well-known carved stone medallion found near St. George in 1863, and now in the museum of this Society. Its origin is doubtful, and the probability is that it is not of Indian workmanship.**

* Excluding carvings, such as that described by Dr. G. F. Matthew in the *Smithsonian Report*, for 1881, p. 672-673, with cut.

** A bibliography of this interesting relic is as follows:—

ANON. Indian Sculpture found near Lake Utopia, Charlotte County New Brunswick, *London Illustrated News*, Vol. 45, July 16, 1864, page 78, 79, with a cut of the stone. The information is given largely on the authority of Mr. C C Ward, of St. John and the stone is said to have been discovered in November, 1863.

JACK, I. ALLEN. A sculptured stone found in St. George, New Brunswick. *Smithsonian Report* for 1881, pp. 665-671, map and cut. This article is reprinted with slight alterations, and a good photograph of the stone, in *Acadiensis, II. 267-275*. It is also given in synopsis in the *Canadian Indian, I. 1891, 265-267*.

ADAMS, A. LEITH. *Field and Forest Rambles, 1873*. An account of the stone is on page 34, and a cut on page 1.

Other cuts of this stone are given in *Scribner's Monthly*, Vol. 15, 465, 1878; and (the same) in Mayer, A. M. (editor), *Sport with Gun and Rod* (Century Co. 1883) 181. A photograph of a cast of the stone is in the *Report of the U. S. National Museum*, 1896, 485.

(3) A large marked boulder found on an old aboriginal camp-site at Passamaquoddy, and now in the museum of the University of New Brunswick. It was discovered and presented to the museum by myself, under the impression that it was a genuine Indian relic, and an account of it, with illustrations, was published by me in the *University Monthly* for March, 1885. But I am now perfectly convinced that the markings are of glacial origin, for they are precisely of the character shown by many glacial boulders.

(4) A carved sandstone boulder on the Oromocto river reported by Mr. C. W. Beckwith, as recorded in the *Transactions of the Royal Society of Canada*, V, 1889, section ii, 228. It was described as situated about a mile above the mouth of Lyons stream, and as having cut upon its surface "a plan or map, apparently answering to the forks of the Oromocto River, with curious figures; some that appeared to indicate men and arrows pointing in different directions. . . . . . There were no letters, and it did not appear to have been made by a civilized being, but looked to me like some old Indian landmark." He adds details as to its location and appearance. In July last, while descending the Oromocto in company with Dr. Hay, we made careful search for this stone, examining every large boulder along the river from near Otter Brook to Lyons Stream. In about the position described by Mr. Beckwith we found a boulder, or, rather, a portion of semi-detached ledge, answering in some respects to his description, but it bore no markings. About one-third of a mile lower down, however, we found another boulder answering even more closely to his description, except that it was some distance out from the bank, and upon this were markings of the character described by him. They were, however, so faint that we missed them upon a first search, and only found them on the almost microscopic search of a second visit. The markings, however, are true glacial or ice scratches, readily resolvable by fancy into arrows and other figures. One of the lines, no doubt that taken by Mr. Beckwith for the Oromocto, is somewhat sinuous, rather

PLATE VI.

PICTOGRAPH (?) FROM FRENCH LAKE.

an unusual feature in glacial scratches, but there can be no doubt as to the entirely natural origin of them all.

Curiously enough, it was upon this same journey that we discovered certain rock-markings which may represent a genuine aboriginal pictograph. While endeavoring to locate the site of the old French settlement on French lake (of Oromocto), we were told of two smooth boulders near by bearing figures carved by Indians. One of them has been built into the chimney of the neighboring mill, and cannot be seen; but the other was pointed out to us upon the shore of the lake, and we made a careful examination and photographs of it. It lies on the south beach of the lake, about 200 yards to the eastward of the ruins of Hilliard's mill, and somewhat above the summer water-level. It is of fine-grained sandstone, with a smooth, slightly rounded, surface, some two by three feet in area. Cut into this surface are three distinct figures, which I went over carefully with chalk, and then photographed, with results shown by the accompanying figure. At first glance we were inclined to reject the local theory that these were Indian carvings, or indeed had any artificial origin at all; but the more we studied them the more possible did it seem that they may be of Indian origin. If so, they would appear to represent Indian totem or tribal signs, carved, perhaps, by Indian youths in moments of leisure, just as our young people carve their names upon prominent places, where the rock is soft enough to allow it. Upon the whole, however, I am inclined to doubt their artificial origin. Despite the remarkable resemblance of one of the figures to a human form, and of another to a stretched beaver skin,* I think it possible, or even probable, they are but a natural freak in the weathering of the rock. If a carving, the work must have been done with a very hard-pointed instrument struck by a heavy mallet, for the figures

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* In this connection, it is interesting to note the following passage in Levinge's *Echoes from the Backwoods*, (London, 1846) I. 103. "The *totem* of the Milicete is the beaver, and a member of the tribe who wished to designate himself would first sketch the figure of the beaver, and then place beneath it his own peculiar *totem* or crest, such as the hawk, or pigeon, the mink, eel or salmon."

are composed of deep pittings, and are not smoothly rubbed in. Again, although these are the only areas of the pittings of any size upon the stone, there are some scattered pittings of the same character, which is to be expected if they are natural, but not if they are artificial. I commend the stone to the study of those learned in such matters. It would not be difficult to secure its transport to a museum.

ARTICLE IV.

# NOTES ON THE NATURAL HISTORY AND PHYSIOGRAPHY OF NEW BRUNSWICK.

By W. F. Ganong.

## 70.—On the Physiographic History of the Upsalquitch River.

Read December 2, 1902; re-written March, 1904.

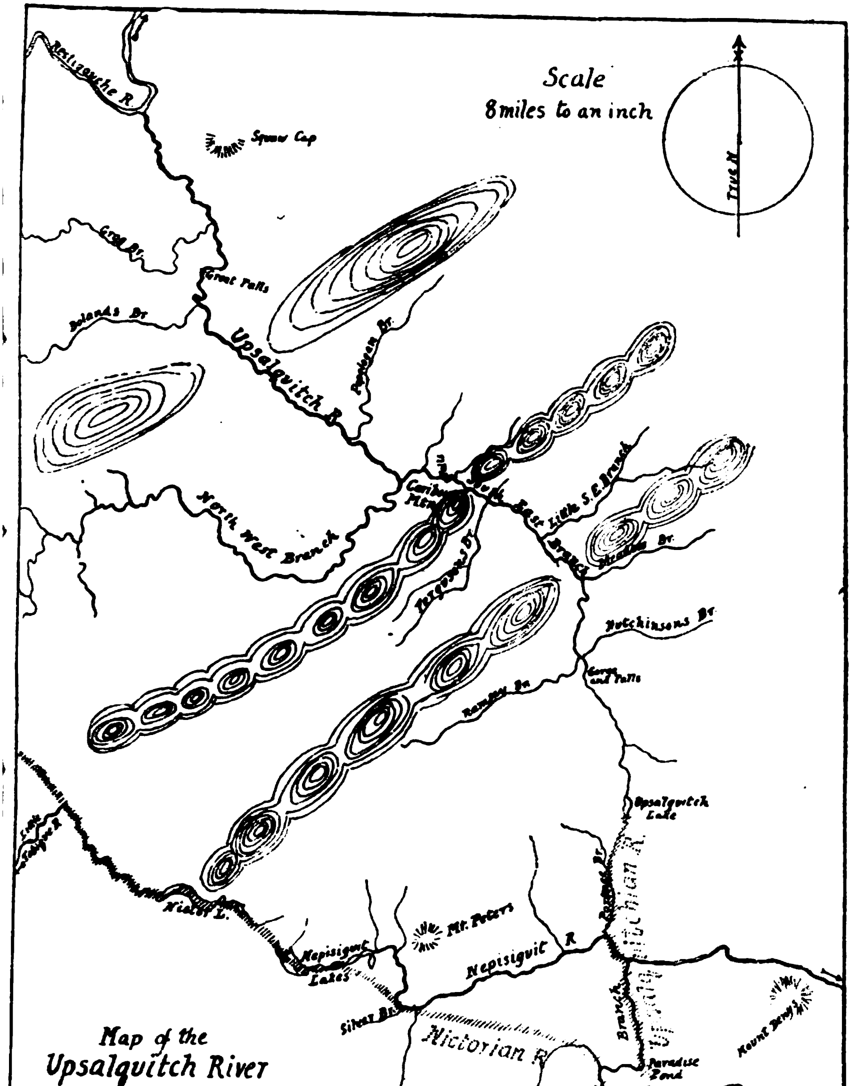
In August, 1902, in company with Mr. M. I. Furbish, I descended the Upsalquitch River from its head in Upsalquitch Lake to its mouth, and made some observation npon its physiography, as recorded below.

First we note the development of our knowledge of the river. On the maps of the French Period only its mouth is shown; its upper waters appear as crude sketches on maps by DesBarres (1780), Bouchette (1815), and others, down to 1820 (or 1821), in which year it was surveyed from its mouth to near the lake by Deputy Surveyor McDonald, whose plan is the original of all later maps to the present. The lake and a few miles of the river were sketched by Berton in 1837, and this sketch was pieced to McDonald's plan to give the representation of the entire river upon the maps of Saunders, 1842, Wilkinson, 1859, and others, which, however, place the lake too far east. This was corrected by the County Line survey of 1872, which gave another sketch of the lake, but the latter was only surveyed for the first time in 1902, as recorded in Note 65. Turning to scientific knowledge of the river, there is little to note. In 1839, Wightman, determining elevations with mercurial barometers for use of the Boundary Commission, descended the river to opposite the head of Jacquet River, to which he portaged, returning apparently by the Tetagouche, but unfortunately few of the localities measured by him can be identified. In 1864 Hind descended the river, making the

notes upon its geology recorded in his well-known Report of 1865. It was next studied by Ells in 1879, whose observations, in the Report of the Geological Survey for 1879-1880, gave us our present knowledge of the geology of that region. It was ascended by Mr. Chalmers in 1884, for the study of the surface geology of the region, and his observations are in the Report of the Geological Survey for 1885. In 1900 a collection of mammals was made at Grog Brook Lake by Thaddeus Surber for the Field Columbian Museum of Chicago, as described in Publication 54, 1901, of the museum. Our knowledge of the elevations along the river is given in Note 62. Its economic history is very brief. It is a rich lumbering river, and much lumbering has been done upon it for more than a century, but it is settled only for some ten miles above its mouth. Sportsmen have visited it frequently, but the only published account of a trip along it that I have found is the very brief one by Dashwood (Chiploquorgan, 40), who ascended it in 1863, and portaged from the west branch to Tobique. The same route was followed by Mr. W. H. Venning on one of his trips, as he relates in Forest and Stream, January 10th, 1903.

The Upsalquitch River* heads in the charming Upsalquitch Lake, which I have described in Note 65. In that and an earlier note (No. 33) I have expressed the belief that Upsalquitch Lake represents only a recent (perhaps post-glacial) head of this river, and that its morphological head, that which it had originally, was in the Main South Branch of Nepisiguit. This implies that the Nepisiguit River from Silver Brook downwards, and from somewhere near Mount Denys upward, originally formed branches of this ancient river, which we may call the *Upsalquitch-*

* Corrupted from the Micmac *Abseiquetch*, said to mean *a small river* (viz., in contrast with the Restigouche, much as we commonly use Little River). It first appeared on Van Velden's map as *Upsatquitch*, which was copied upon Purdy's map of 1814 in its present form, apparently by a simple misprint of the *l* for a *t*. But this form persisted upon all maps, apparently without exception, to the present, and has determined the present literary (school, tourist, and other map-using public) pronunciation. Locally, however, by Indians, lumbermen and others, the *l* is rarely, if ever, heard, the river being called *Apstegouche*, *Absequish*, etc. The names of the various branches are mostly for the various lumbermen who first operated upon them, except Popelogan, which is said by the Indians not to be Micmac, and which was perhaps given by some early American lumbermen for one of the places of that name in Maine, or southern New Brunswick.



Restigouche R.
Squaw Cap
Scale
8 miles to an inch
True N.
Upsalquitch R.
Bolands Br.
Popelogan Br.
North West Branch
Caribou Mtn
North East Branch
Little S.E. Branch
Ferguson Br.
Meadow Br.
Hutchinsons Br.
Gorge and Falls
Ramsey Br.
Upsalquitch Lake
Nictor L.
Nepisiguit Lakes
Mt. Peters
Nepisiguit R
Silver Br.
Victorian R
Main South Branch
Paradise Pond
Mount Denys
Norwest Miramichi
Map of the
Upsalquitch River
and related waters
to illustrate
their physiographic history
by W F Ganong
March, 1904

*ian River.* This conclusion is fully sustained by the studies of 1903, described in a later note (No. 77), but with a modification there indicated, namely, it was not originally the entire South Branch which formed the head of this river, but the part of it from its mouth to near Paradise Pond, together with the continuation of that valley southward, the latter part being now occupied by the head of the Northwest Miramichi. The upper part of the present South Branch seems originally to have formed the head of a distinct river, the Nictorian River (Note 77), though it early became united with the present South Branch. These relations are shown by the shaded bands on the accompanying map. There are still two points to be determined in this connection; first, as to the location of the head of the easterly branch, which was possibly in the narrow-walled valley a little above Mount Denys, (or perhaps nearer Indian Falls), and second, the period at which these waters were turned down the Nepisiguit, whether in glacial or pre-glacial times. So low is the drift barrier separating Portage Brook from Upsalquitch Lake (Portage Brook could now be turned into Upsalquitch by an excavation of only a few feet), that I am inclined to think these upper Nepisiguit waters must have flowed into the Upsalquitch up to the glacial period, and that it was some form of glacial action which produced the change.*

The present Upsalquitch is the only considerable river of the Province having a northerly flow, a phenomenon with a well-known glacial explanation (viz., the tendency of the southward advancing, and of the northward retreating, ice-sheet to dam up northerly flowing rivers and send their waters in southerly directions). It issues from the deep valley of Upsalquitch Lake over a typical drift dam. Immediately, the valley opens out greatly, and the river, here very small, wanders about with a gentle cur-

*The change could not have been simply due to the damming of the Portage Brook-Upsalquitch Valley by glacial drift, for this would necessitate a post-glacial outlet to the eastward, which does not exist. The change appears rather to have been of an "inter-glacial" character, such as is being found to account for the peculiarities of valleys in New York State. Another possibility is that the advancing ice-sheet coming from the north, at the opening of the Glacial period, blocked and dammed the Portage Brook valley, sending the upper waters over the lowest outlet, which happened to be at the eastward, and that those waters kept that direction as a sub-glacial and inter-glacial river, thus cutting out a valley much larger and riper than a post-glacial valley could be.

rent over drift in a flat country, at times almost smothered in alders, for some six miles. Then, for some two miles it is more rapid, its bed is rougher, with some ledges, until, eight miles from the lake, it plunges into a typical, post-glacial gorge two miles in length, in which the water, by a series of falls and rocky rapids, drops some 150 feet.* In the gorge are two sets of beautiful falls, one near the head of the gorge, of some three or four irregular pitches, in all about forty feet, and another, a quarter of a mile lower down, also of some three or four pitches, an upper nearly vertical of twenty feet, and a lower, also vertical, of ten feet. The walls are here very steep and close together, and with their summit of forest present a wild and beautiful aspect. Altogether the gorge and falls deserve to rank among the finer of the Province, although, owing to the small size of the river, they are surpassed in magnitude by several others. The preglacial channel appears to have been on the west bank, perhaps into the present Ramsay Brook.

The river issues from this gorge just above Ramsay Brook, but not as above into open country. On the contrary, it runs over a very rough bed in a deep, winding, narrow valley, cut 300 or 400 feet into a plateau country, to a mile or more below Meadow Brook, where the valley, at the place marked as Devonian on the Geological map, abruptly opens out. This part of the valley just described is much like parts of the Nepisiguit, the Little Southwest and the Northwest Miramichi, though somewhat less extreme in its characters, and without doubt the same explanation, whatever it may be, applies to the origin of them all.

After issuing from the deep valley a mile below Meadow Brook, the river, now rapidly increasing in size, winds about with a smoother current through a wider valley, and develops a considerable flood-plain, including many fine, though small, intervales. The hills, evidently the cut edge of a plateau, are back from the river and more rounded and less lofty than above, and

* Hind (Geological Report, 1865, 129) refers to the gorge and falls, and makes the river fall 420 feet, while Ells (Geological Report, 1879-80, 3 D) makes it 130 feet. I did not measure it, but think it must be greater than Ells makes it, because I made the lake 864 and Ramsay Brook 527 feet respectively above the sea, while the drop from the lake to the gorge is not very great.

this character continues to the Falls, two miles above the Forks. Here the river drops over a symmetrical stair-like fall of some four or five steps, navigable with some difficulty for a canoe. Just to the westward of the Falls rises Caribou Mountain, a prominent bare mountain, some 750 feet above the river, and 1,100 feet above the sea, from which a grand view of all the surrounding country can be obtained. On ascending it, one finds that it is but part of a marked and lengthened range running almost exactly southwest (true) with many abrupt rounded summits, presenting all the aspects of a typical intrusive ridge. Moreover, the same range can be traced to the northeast across the river, where it is equally lofty, though less abrupt.* Now this mountain is composed of felsite, and it is a part of it which here forms the fall in the river. In this prominent range, accordingly, we appear to have a great ridge or immense dyke of intrusive felsite, forming so marked a feature of the topography of this region, and a band showing this formation should be inserted upon the Geological map.

This range in its far westward extension is the same abrupt range of rounded summits, I believe, as can be seen from the top of Sagamook, off some eight or ten miles a little to the west of North (true), and it may even continue somewhat beyond, and form a part of the watershed between the Little Tobique and the Northwest Branch of Upsalquitch. From Caribou Mountain there can also be seen off to the southward, some four or five miles away, another parallel and similar range of hills, evidently the so-called pre-Cambrian band marked on the Geological map; this range extends northeastward into some very lofty hills, and southwestward into a general mass of elevated country, with some marked peaks, continuous, I believe, with the range ending in Mount Gordon or Nictor Lake, and perhaps extending beyond along the Geologists' Range. Between these two ranges, the country marked on the map as Silurian is much below their level and somewhat flat. Furthermore, off to the northward, some five or six miles away, rises a lofty smooth-topped ridge, which

*Ells (Geological Report, 1879-80, D, 37) refers to this mountain, but he did not ascend it, and he considered the felsite area as detached and of small extent.

falls away on the westward before reaching the river, and this, although much more regular in outline than the Caribou Mountain range, is, I think, probably also another parallel felsite range.* It appears to cross the river half way between Popelogan and Boland's Brooks, and to form in its southward extension the divide between the West Branch and Boland's Brook, and the course of the West Branch is apparently determined by erosion of the softer rocks between these two parallel ridges. Felsite dikes cross the river at several points lower down the Upsalquitch at places marked on the Geological map, and again at three different points not marked on the map, below the Great Falls. All of these dikes have a general northeast and southwest direction, indicating an extensive series of these parallel bands of felsite, and erosion between them has probably determined the dirction of the branches of the river. From the top of the mountain one can follow the valley of the Upsalquitch far to the northward, where it appears as a broad, shallow trough (narrowing where crossed by the felsite dikes), into the centre of which the river is cutting a deeper channel. It is plain that the Upsalquitch river must be very old, not only because of the breadth of this trough-like valley, but also because of the way it cuts across the felsite ridges; it must have been formed before the country was carved down

* There is a lofty round-summited intrusive looking ridge, which is very probably of this same character, running northeast from Mount Peters, which may be continuous with Naturalists group near Upsalquitch Lake in that direction, and with Teneriffe, or the Green Range, Winslow and possibly even with Matthew and Bald Head, to the southwest. The presence of this series of northeast and southwest parallel ridges, with Silurian rocks, in part, at least, between them, is quite in harmony with, if it does not actually substantiate, Professor Bailey's views as to the geology of the Tobique-Nepisiguit region. (See his "Notes on the Highlands of Northern New Brunswick" in this Bulletin, V. 83). The ridges might be of late or post-Silurian intrusive felsite forced up among, and in some case forced over, the Silurian strata. The fact that Silurian rocks occur between the ridges farther north, makes it the more likely that the same is true in the Tobique-Nepisiguit country.

It is possible this system of parallel ranges may be traced a little farther. One may find some evidence for one of them in the line of Missionaries Range, LaTour, Wightman, Feldspar Mountain, and Mount Edward, and perhaps another in Mount Denys, Cartier, Ray. mond, DesBarres, and perhaps Nalaisk, but it must be admitted that they are not very distinct, and their existence is perhaps doubtful. An attractive feature about this extension of the ranges is the clear explanation it gives of the origin of the Nepisiguit above and below Portage Brook, for it would make these parts strictly homologous with the branches of the Upsalquitch farther north, such as Ramsay Brook and Hutchinson Brook, etc. But this subject needs more study.

between the dikes, viz., when both hard dikes and softer rocks all stood at one level above the present ridges, which is precisely what the peneplain theory requires. Then in course of time the softer Silurian rocks would be carved out between the harder ranges, determining the courses of the larger branches, and leading to the present condition.

Resuming our course down the river, the valley continues of the open-flood-plained type, and the river swift, but smooth, for two miles to the junction with the Northwest Branch. We did not ascend this branch, which looks alluring enough at its mouth, but we have been told by those familiar with it that it is the finest in all respects of the two branches, being easy of navigation for a great distance, and very charming in scenery.* Indeed, from the descriptions, I would infer that there is very much the same difference between it and the much more broken east branch, that there is between the Little Tobique and the Right Hand Branch of Tobique. This resemblance is not accidental, but in a sense genetic, for the west branch of Upsalquitch flows in the same kind of Silurian rocks, and is probably of the same age as the Little Tobique, while the east branch of Upsalquitch and the Right Hand Branch of Tobique flow across bands of older and harder rocks, and are likewise probably of the same age.

Below the Forks the Upsalquitch is a large and very charming river, of grand scenery, swift and abundant clear water affording ideal canoeing, extensive intervales, and all the beauties characteristic of the best of our New Brunswick rivers. As to its size, this surprised us from far up in its course; it is a far larger river than the maps give any idea of, and than its appearance at its entrance into the Restigouche implies. The valley continues broad and open for a few miles, to below Popelogan Stream, and then it appears to narrow somewhat, and low banks appear nearer the stream. This character becomes more marked in descending until the river comes to run in a deepening and

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* An old portage route is said to have existed from this branch to the Nictor [Tobique,] which it apparently reached a few miles below the lake at the big bend. [Dashwood, Chiploquorgan, 41, and Venning in Forest and Stream, Jan. 10, 1903, page 32] The portage from the lake to Portage Brook is described in Note 65.

rather steep-banked, though still somewhat mature, valley, closely resembling the valley of the main Restigouche. This is, I think, without doubt, due to a fact suggested by the appearance of the valley from Caribou Mountain, namely, the modern river is cutting down below the bottom of its old trough-formed valley. The fact that this river, so closely resembling the Restigouche, is doing this, suggests that the Restigouche itself is in reality a rejuvenated stream at the bottom of a wide trough valley, a subject needing farther study. The river continues of this general character to the Great Falls, below which it opens out again into a broader valley. The Great Falls, an irregular rapid easily run in canoes, is clearly post-glacial with the pre-glacial valley cutting across the bend on the right bank. Below this, three dikes of felsite are passed, high terraces appear, and the uppermost settlements are met with; finally the country opens out, estuary-like, and at length the Upsalquitch, by a narrow mouth, joins the Restigouche.

Viewing now the probable physiographic origin of the river as a whole, we have an origin and history, I believe, in general much like that of the Tobique (Note 45). The true head of the river lies south of the Nepisiguit, in the crystalline rocks forming the central watershed, and must have been formed at the same time with the Nictor and Right Hand Branch rivers, on the surface of the oldest of the two peneplains, into which, I believe, New Brunswick was formerly carved. It then followed the general slope of the great peneplain northward along approximately its present course, and probably originally flowed into the St. Lawrence by the course either of the Metapedia, or, more probably, by the Patapedia. When the country was elevated and stood at the level determining the second peneplain (the boundary between the two lying a little north of the lake) it kept its course, but carved its way down into the plain, (the Restigouche forming at this time and turning it into Bay Chaleur). reaching the harder felsite ridges and cutting into them, and carving out the softer rocks between; this continued until the soft rocks were carved to near the present general level of the Silurian plateau, and the rivers ran in broad, shallow troughs. Then came the eleva-

tion which permitted the rejuvenation of the streams and their cutting below the trough of the older valleys, which process is still in progress. Finally came the glacial period, which beheaded the Upsalquitch, and turned it out of its course in places, as we find it at present.

## 71.—On Some Peculiar Tree Forms Found in New Brunswick.

Read April 7, 1903.

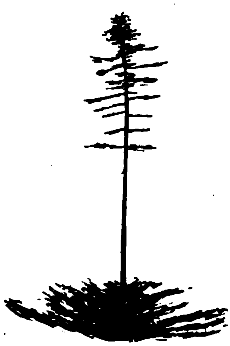
In earlier notes in this series (Nos. 22 and 27), I have called attention to some remarkable tree forms, with their causes, noticed in New Brunswick, and to these the three following may be added. The illustrations are in every case traced carefully from photographs, and hence are approximately accurate.

The first of the three figures represents an apple tree, ten feet high, standing near the shore of Rougie Bay, near Waterside, in Albert County. A low valley extends thence through Shepody, and through this valley the southwest winds, sweeping up the Bay of Fundy, rush with great force for most of the summer. The winds in this region are strong, for very much the same reason the tides are high, namely, the Bay of Fundy is funnel-shaped, causing a concentration of both water and air currents, with an intensification of both. The tree here figured is not only bent mechanically to leeward, *i. e.*, the northeast, but it is also aborted (by hindrance to growth and death of branches through excessive transpiration) on the windward side, and it is to a combination of these causes that such tree-forms are due. This is the most extreme example of wind-effects that I have myself seen, nor have I found any better described in the literature of the subject.

The second figure represents a spruce, which I photographed some years ago on White Head Island, Grand Manan. The

bank here is rapidly washing away (no doubt because of a progressive sinking of the coast), and this had evidently deprived the tree of support when very young. It has accordingly sunk down, at the same time bending geotropically upward, until it now rests against the bottom of the bank, while the main root ascends vertically upward for some six feet (the tree itself being about that height), and then bends over horizontally into the soil at the top of the bank, the present approximate outline of which is shown by the curved line. Whether or not the tree has taken root also in the bank at the base, my notes unfortunately omit to state. This case shows two interesting facts; first, that the washing away of the banks must be at times very rapid, (though apparently intermittently), and second, it shows that woody plants must retain their powers of geotropic bending much later than is commonly supposed, and than the nature of the tissues would lead us to expect.

The third figure represents a form of spruce very common on the elevated open barren plateaus just east of the valley connecting the Nepisiguit and Upsalquitch. All such trees, which grow only to about ten feet in height, show a lower very dense part extending up a foot or two from the ground, a living pyramidal rather close top, and a branchless bare trunk between. This form is due, I think, to the following causes. Growing as these trees do in the crevices of the rocks of windy bare plateaus, they must at times, especially on the bright, warm, windy spring days, be subjected to an intense transpiration when the water supply is very limited, or, in the early spring, still frozen, and hence unavailable. At this time the lower branches are protected from excessive transpiration by the snow covering, and in



part by their proximity to the ground, and hence are preserved. The new branches at the top, while very short and compact, are able to obtain a sufficiency from the stem, but as they grow longer they obtain their supply with more and more difficulty until they finally perish, thus producing the advancing bare area behind the young tip. The result is probably purely a physical result of the attendant conditions, with nothing in it of adaptation.

## 72.—THE LOCATION OF THE HIGHEST LAND IN NEW BRUNSWICK.

Read October 6, 1903.

Every New Brunswicker must have a desire to know where in the Province lies the highest point above sea-level; and the subjest is one also of considerable topographical and physiographic importance. Yet up to the present time it has been impossible for anyone to say where that point is. Such study as has been given to the matter has seemed to show, as recorded in earlier notes of this series (Nos. 5, 19, 25, 34), that Big Bald Mountain, on the South Branch of Nepisiguit and Mount Carleton, three miles south of Nictor Lake, are the two highest mountains of the Province; but it has been uncertain which of the two is the higher, though the evidence seemed to favor the former. Now, however, as the result of measurements made during a recent visit to Big Bald in company with my friend, Professor A. H. Pierce, I am able to definitely settle the question as to their relative heights.

Before presenting the new facts, however, we should note the evidence for the published heights of these two mountains. The height of 2,675 feet recently given for Carleton rests upon aneroid measurements made by myself in 1899 and in 1902 (Notes 25, 34, 62). The height of 2,700 feet commonly assigned to Big Bald was first attached to it upon the Geological map, published in 1887 (or 1888). Now this map for the Big Bald region is based solely upon the observations of Dr. R. W. Ells, who was there in 1880, but it is a curious fact that in his report he gives the height of the mountain, presumably as the result of a single aneroid measurement, as 2,330 to 2,430 feet in one place (Report 1879-80, 32D), and 2,500 in another (35D), but nowhere as 2,700 feet. In answer to my question, as to the cause of the discrepancy be-

tween report and map, Dr. Ells, as earlier noted (Note 5), disclaimed responsibility for the greater height given on the map. Later, however, Dr. Chalmers wrote me that he had made the mountain over 2,700 feet, as a result of the re-calculation of Ells' data (Note 25), whence I conclude that Dr. Chalmers is authority for this height on the map.

Our measurements of Big Bald were made on August 22, 23 and 24, 1903, and consisted of six independent observations made exactly synchronously with the regular barometric readings at Fredericton and Chatham. The instruments were the two excellent aneroids, used with precisely the same precautions as to correction for index error, temperature and weather, as previously described (Note No. 53), and the results were calculated in the same manner from the same tables. One of the readings was rejected because of a thunder storm prevailing at the time, and the other five corrected from the Fredericton base gave 2,373, 2,341, 2,364, 2,331, and 2,345, averaging 2,351 feet above sea level. The five corrected from Chatham gave 2,272, 2,292, 2,250, 2,235, and 2,250, averaging 2,259. The cause of the discrepancy in the results calculated from the two bases will be noted later (Note 76), as will the reasons why greater weight must be given to the Chatham than to the Fredericton results. The height must, therefore, fall in the vicinity of 2,300 feet, and under rather than over that figure. Thus Big Bald is proven to be very much lower than Carleton.

So unexpected and altogether surprising is this result that it will naturally be questioned. It may be argued that my figures are somewhere in error; but not only were they all made with a care commensurate with the interest and importance of the problem, but they are all consistent with one another, and could hardly all be in error in the same degree. Again, it may be assumed that my instruments are out of order; but not only were they carefully compared with the standard mercurial barometers at Fredericton and St. John, both before and after the journey, and the index errors taken into account, but also they are the same instruments used in precisely the same manner as for the determination of the height of Mount Carleton, so that

they are at least conclusive as to the relative heights of these two mountains. Further, certain measurements which I made this year of the surface of Nictor Lake gave results in close agreement with those of previous years. Allowing, however, the greatest possible error under the circumstances, it could not bring Big Bald up to 2,400, nor Carleton down to 2,600, so that Carleton still is to be ranked as much the higher.

There is, furthermore, other evidence confirmatory of this height. Big Bald rises from the bed of the South Branch, on its south side, less than 600 feet, according to our direct measurements. Now, we found the South Branch some four miles north of the mountain to be, as a mean of two measurements, just under 1,600 feet in elevation. The current of the river between the two places is very gentle, largely stillwater, and it cannot fall 100 feet. On a liberal estimate, therefore, the height of the mountain would not exceed $1,600+600+100=2,300$ feet. That the mountain does not really rise more than to this height above the river is evident at a glance to anyone accustomed to the measurement of elevations. While very conspicuous from parts of the surrounding region, because of the contrast of its bold, bare summit with the wooded hills in the vicinity, it is, so far as height is concerned, a very disappointing mountain to visit, and it is certainly somewhat surpassed in height by other wooded hills in the vicinity. That it has come to be accepted as the highest in the Province is due, of course, first of all to the error of the Geological map, but this has been aided by a common psychological phenomenon, namely, the tendency in the minds of men to attribute remarkable properties to that which is remote and of difficult access. Big Bald is in the very heart of the New Brunswick highlands, and there is no spot in the Province more difficult to reach; hence it is easy to imagine it is also the highest place.

Mount Carleton is, therefore, the highest land in New Brunswick which has been measured. The Province is now sufficiently well explored to make it seem certain that in none of the less known parts can any mountain exist equalling it in height. The highest point of land in New Brunswick may, therefore, be accepted as the summit of Mount Carleton.

## 73.—The Physiographic History of the Oromocto River.

Read November 3, 1903.

One of the most remarkable of New Brunswick rivers, both in its own features and in its relations to neighboring waters, is the Oromocto. In July last, in company with Dr. G. U. Hay, I visited the Northwest Oromocto Lake and descended the Oromocto River to its mouth in the St. John. The observations I was able to make, together with certain conclusions drawn from them, are presented below.

The development of our knowledge of the river may be briefly traced. As it formed a part of an important ancient Indian portage route from the St. John to Passamaquoddy and the Penobscot, it was early know and markedon the maps. It is indicated, as *Ramouctou,* crudely on the Franquelin-de Meulles map of 1686, and is given with remarkable accuracy on the still unpublished de Rozier map of 1699, which, with many others later, call it the *Medocta.** Its modern representation begins with a fair sketch on Sproule's map of the southwest part of the Province, of 1786,** in which the lake is probably represented from a sketch by Lieutenant Lambton, who crossed it in his winter trip from Fredericton to St. Andrews in 1785, while the lower part up to the Forks is laid down from surveys made in connection with Loyalist land grants. The Northwest Lake was carefully surveyed in 1831 by O'Connor, whose very detailed map is the original of all down to the present, including that accompanying the present paper, the topography of which is photographically reproduced from an exact tracing of his original manuscript.***

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* An error of which the origin is explained in Trans. Royal Soc, Canada, II, 1896, ii, 250; III, 1897, ii, 372.

** Published in Trans. Royal Soc. Canada, VII, 1901, ii, 412.

*** The Magaguadavic on this map is reduced photographically from the very detailed and accurate map made in 1797 for the International Boundary Commission, of which the original Ms. Field-book is now in possession of Rev. Dr. Raymond, of St. John, to whom I am indebted for its use. The old Indian portage path, now apparently unknown locally, is marked at two ends very accurately on these two maps [O'Connor's and the Survey of 1797,] and its intermediate course may be inferred from the fact that it must have followed the low place in the ridge a little north of a direct line between the two ends. It is of interest to note that by far the finest camping place on the lake is at White Sand Cove, near the Oromocto end of this portage. For other facts about it, consult Trans. Royal Soc. Canada, V, 1899, ii, 241. A reported Indian carving from this river was found by us not to be genuine,

The Northwest River from the Forks to Lyons Stream was surveyed in connection with land grants prior to 1810, but the part from Lyons Stream to the lake has not hitherto been surveyed at all, and I had the pleasure of making a traverse survey of it during our trip, the results of which are given on the accompanying map. The South Branch and Back Creek were surveyed prior to 1800 in connection with land grants, and the south Oromocto Lake and stream were sketched somewhat later.

The river was settled from its mouth to the Forks by Loyalists in 1784-86; by their descendants up the South Branch to Back Creek, and up the Northwest towards Lyons Stream prior to 1810; the western shore of the Northwest Lake was settled by an expansion from Harvey settlement after 1837, and later immigrants after 1840 have settled between Back Creek and the South Branch, and a few settlers live near the South Lake. The remainder of the river, including the east and south sides of the Northwest Lake and the river to Lyons Stream, and most of the South Lake, with the South Branch from near Back Creek, are still unsettled forest. Much lumbering was formerly done on the lakes and river, especially in the years from 1830 to 1865, but it has now ceased.

Turning now to scientific knowledge, we find that the geology of the basin, which is of carboniferous conglomerates and sandstones, and comparatively simple, was first observed, and was known in general to Gesner, who mentions it briefly in two of his Reports. The geology of the vicinity of the Northwest Lake was

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Consult an article "Upon Aboriginal Pictographs Reported from New Brunswick" in this Bulletin.

The local pronunciation of the name of the river is *Erramucta*, which must be an old form, since it is found practically thus, *Erramouctau*, on Allen's map of 1786 (Trans. Royal Soc. Canada, VII, 1901, ii, 264). Of other names, *Kelly* and *Bedford* [Tracey] are said to be for early lumbermen, as doubtless others are also. The names on the maps are those commonly in use by those who know the river, while certain of O'Connor's names not now in common use I have put in brackets. *Indian Point* is explained by a local legend, to the effect that an Indian having stolen a girl on the St. John was fleeing by the portage route to Penobscot when he was overtaken and shot by her relatives on this point; but another tradition derives it simply from an Indian camping place in the cove near by.

For very much local information about the lake and river I am greatly indebted to Mr. Thos McFarland, of South Tweedside, as well as to Mr. C. L. Tracy, of Tracy Station, and to Mr. William Clark, of Flume Ridge. I have obtained from them much more information than I have used in this article, but which will appear later in another connection.

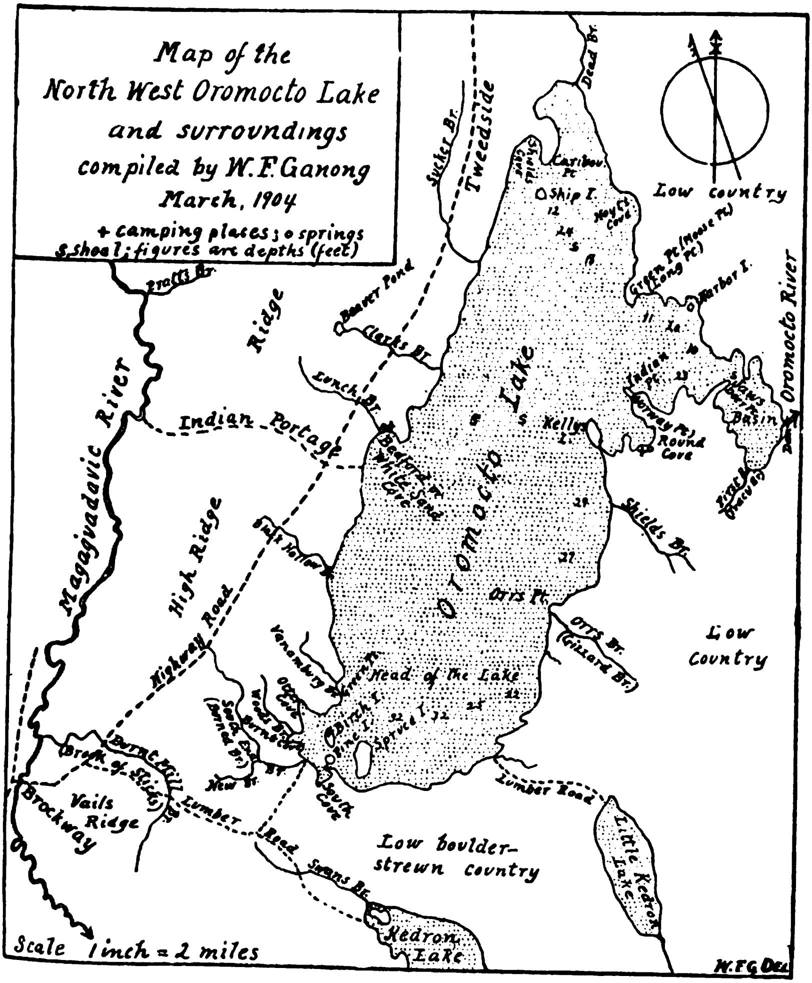
first studied with some care and described by Charles Robb in 1868. (Report of the Geological Survey for 1866-69). Studies of other parts of the basin have been made by Bailey, Matthew and Ells. (Reports of the Geological Survey of Canada, 1870-71, 1872-73, and 1878-79 D). The surface geology of the lake has been described from a visit in 1883 by Chalmers (Report of the Geological Survey of Canada, GG, 1882-84) who gives also an appreciative account of the scenery, especially towards the north. No studies of any kind upon the natural history of the basin appear to have been made prior to our trip. I understand from Dr. Hay that his observations of the plants along the river showed only the common plants of New Brunswick, with none especially noteworthy.

Our study of the river shows that it falls naturally into six sections, which I shall consider separately.

1. *The Northwest Lake.*—The Northwest Oromocto Lake, some eight miles long* and 2½ in extreme breadth, lies in a north-and-south valley with high ridges (some 200 feet over the lake), on the west between it and the Magaguadavic, and a low country to the east and south. It empties from the eastern side. Its shores are nearly everywhere rocky, for the most part of middling-sized boulders, often pushed up into marked ice-dykes, sometimes pavement-like, and including many morainic points of small boulders, extending often as shoals far out into the lake. In many places, notably at Ship Island, Kelly Island** and the northeast coast, the shores are conglomerate ledges, often worn by the water into caves. Elsewhere, especially at White Sand Cove and on the southeast shores, are some fine sand beaches. The three islands at the southern end of the lake are of glacial drift and their axes have, with the moranic points, the usual northwest and southeast direction. The depths of the lake are extremely irregular, and in many places it is very shoal, both near the shores and also upon certain island-like shoals, apparently ledges, which come nearly to the surface, especially between Ship Island and Green Point and between Kelly's Island and the western shore. On the

* Locally it is insisted that this lake is nine miles long, but O'Connor's map, made with much care and checked by mumerous intersections, makes it less than eight miles.

** A fact worth mention about this island is its use locally as a kind of large game trap. Deer and other animals cross to it from the shore by the bar of gravel and sand, indicating their presence by their tracks on the sand; they are then driven from the woods of the island by hunters, to fall before the guns of others stationed at the bar.



Map of the
North West Oromocto Lake
and surroundings
compiled by W. F. Ganong
March, 1904
+ camping places; o springs
S. Shoal; figures are depths (feet)
Low country
Dead Br.
Tweedside
Sucker Br.
Caribou Pt.
Ship I.
Green Pt. (Moose Pt.)
Long Pt.
Harbor I.
Oromocto River
Ridge
Beaver Pond
Clarks Br.
Lunch Br.
Magaguadavic River
Indian Portage
Oromocto Lake
Indian Pt.
Kellys I.
Round Cove
Basin
White Sand Cove
High Ridge
Shields Br.
Otts Pt.
Otts Br. (Gillard Br.)
Low Country
Highway Road
Vanambury Br.
Head of the Lake
Birch I.
Pine I.
Spruce I.
Otter Cove
South Cove
New Br.
Lumber Road
Vails Ridge
Brockway
Low boulder-strewn country
Swans Br.
Little Kedron Lake
Kedron Lake
Scale 1 inch = 2 miles
W.F.G. Del.

shoals west of Kelly's Island, the boulders have been pushed, apparently by ice action, into a curious kind of atoll, (evidently homologus with the ice-dikes of the shores) such as I have not elsewhere noticed. The moderate depths found by us near the shores are marked on the map; O'Connor states on his map, however, that the "fine open bay" formed by the southern expansion of the lake was found by him to be 72 feet deep by soundings, which is in conformity with the rule for these glacial lakes which are usually deepest towards their southeastern ends. The elevation of the lake above sea-level is in the vicinity of 400 feet,* and it undoubtedly is, as locally stated, higher than the Magaguadavic to the west.

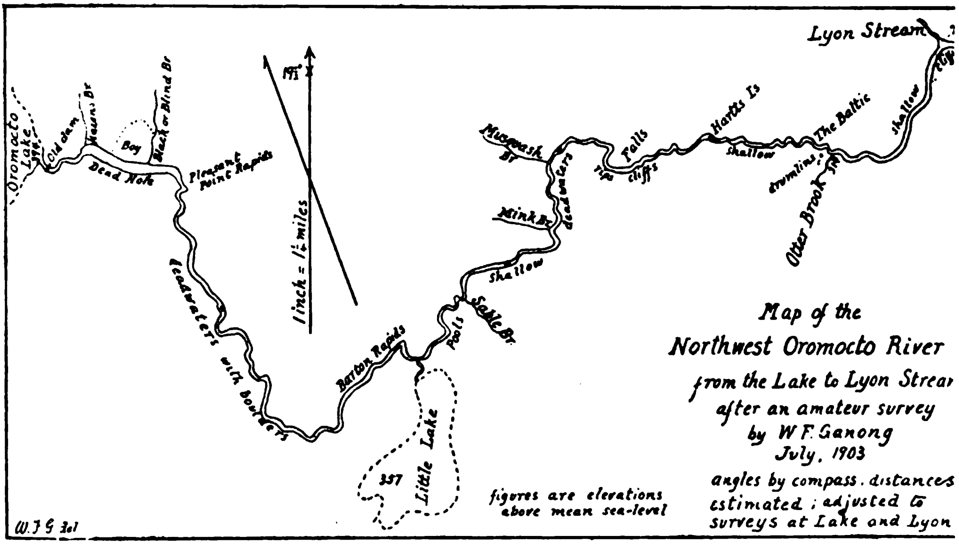
Turning now to the interesting question as to the origin of this lake, which lies directly across the direction of the river to which it now belongs, I think there is no doubt that Mr. Chalmers' opinion that in pre-glacial times its valley emptied southward through the low drift-filled valley to the Kedron and thence into the Magaguadavic, is perfectly correct. It lies therefore in an old valley parallel with the Magaguadavic, and emptying southward and does not belong morphologically to the Oromocto at all. Mr. Chalmers also calls attention to an apparent pre-glacial valley between the lake and Cranberry lake basin, which I also noticed. But it appears to me this valley is rather a continuation of Deadwater Brook, and I believe it can be traced farther,—east of Magaguadavic Ridge to Little Magaguadavic Lake and beyond. This would make a continuous valley parallel to that of the Magaguadavic and separated from it mostly by high ridges, an arrangement perfectly in conformity with the river structure of this region as discussed in a later note,** (No. 75).

2. *The Northwest Oromocto from the Lake to Lyons' Stream.*—Leaving the lake on its easterly side the river flows with a gentle current, making easy canoeing, through long reedy dead-

* Robb, Report, 179, gives it as 370 feet, without mentioning the source of the information. This was perhaps from a preliminary survey for the Western Extension Railway which was made a few years earlier, and passed close to this lake. Chalmers, Report, 18, gives it as 417 feet, of course from aneroid measurements. I made it, as the mean of ten very careful measurements with aneroid, synchronous with and checked from the barometic station at St. John (for lists of readings from which I am indebted to the Director, Mr. D. L. Hutchinson), as 394 feet. It will doubtless prove, when exactly levelled, not to exceed 400 feet. Indeed it is difficult for me to see where it manages to make that much drop between the lake and the Forks, the latter lying practically at sea level. Other heights measured by us along the river gave these results: Little Lake, 357; Mouth of Otter Brook, 314: Mouth of Lyon Stream, 282.

** It seems to me very likely that the Magaguadavic itself had a pre-glacial, or some yet earlier, course into the Kedron by way of the low ground of Brook of Sticks and Swans Brook; and it may even have had a very early or original course across the dip in the ridge west of the lake to Little Kedron and Piskahegan. See Note 75.

waters and stillwaters separated by occasional bouldery rips of little fall, in a flat wooded country showing occasionally morainic knolls, down to Little Lake, a very pretty lake, connected with the river by a short stream of little fall. (Compare the map). Below this, for a mile, the river forms a series of long quiet pools, broken by occasional small rips, with a heavy border of over-hanging vegetation; a charming canoe stream. This is followed by shallows and rips, and some deadwaters, down to Musquash Brook, where the river bed becomes rougher and of greater fall; the




banks begin to rise in rocky ledges, and presently, at North Branch Falls, occurs a typical post-glacial low fall, or bad rapid, below which the banks are still higher, rising to cliffs 50 to 80 feet high, and the valley is typically post-glacial. Below Hartt's Island the banks become lower and the valley opens out, while the river flows swiftly and roughly through an open country with much drop over a bed partly of boulders and partly of flat ledge rock, between banks mostly low but rising at times into morainic hills; and this continues to Otter Brook. Just above this brook, on the same side of the Oromocto, in open burnt country, are two of the most per-

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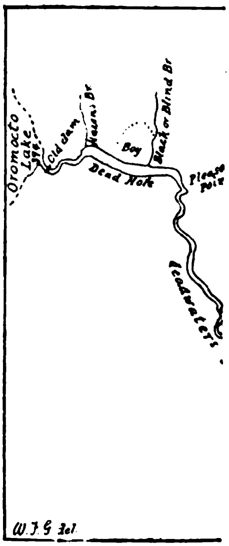


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fect drumlins, one of them conical, that I have seen in New Brunswick. Below this the river continues very rough with much fall and many ledges for nearly two miles, where again the banks rise into rocky ledges, and at Lyon Stream the junction of river and stream is in a rocky post-glacial valley, some 30 feet deep. Below this the banks again fall off and the country gradually opens out; the river has much fall and flows for the most part over a flat conglomerate-ledged bottom. Gradually it broadens and develops some intervales and low terraces, but below Hardwood Creek the banks again rise and the valley is once more post-glacial, with banks often of vertical rock some forty or fifty feet high; then these fall off and the river reaches a wide valley in which the Yoho unites with the Oromocto.

Reviewing now this part of the river it seems plain that from the lake to Yoho stream, this valley is all post-glacial, and that it cuts directly across three, and perhaps four, low ridges* and their intermediate shallow valleys, which in pre-glacial times drained from northwest to southeast, probably into the present Piskahegan and Shin Creek. There is probably a low ridge just east of the lake, forming the eastern boundary of the old valley now occupied by the lake, and east of that lies the shallow valley across which the river now wanders. It is very likely that this valley drained through Little and Peltoma lakes into the Piskahegan and Magaguadavic (compare the map) in pre-glacial times. The next ridge to the eastward would be that extending from Roach Settlement, crossing the river at North-Branch Falls and extending between Shin Creek and the Piskahegan. East of that comes another valley in which probably Lyon Stream belongs, the pre-glacial position of which must have been either farther east or farther west, doubtless the latter; and it is likely that this stream, (formerly extending through the gap at Harvey to Cranberry Lake), flowed in pre-glacial times through the present Otter Brook valley into Shin Creek, while earlier than that, there is good reason to believe, it flowed across the southern highlands into the Lepreau (as discussed in Note 75). East of this lies another ridge and then a small unimportant valley occupied only by Hardwood Creek, also doubtless emptying pre-glacially into Shin Creek, and east of that another ridge bounding the Yoho Stream. If we ask now why this part of the river took this direction across the ridges, the answer would seem to be this, that these shallow valleys in the glacial period were filled with drift, and the new stream, turned by a glacial dam from its old course into

* The rocks of these ridges are nearly horizontal, showing they are ridges of erosion and not anticlines.

Kedron, found its lowest outlet to the eastward, where it naturally followed the direction of the general slope of the country, which is here to the northeast. It has since cut to the rock bottoms of the two eastern valleys, as well as through their intervening ridges, but not to the bottom of the western valley, where it still runs over the drift.*

3. *The Northwest River from the Yoho to the Forks.*—At its junction with the Yoho the character of the Oromocto changes completely. The valley is broad, open, mature; the river, still shoal and swift, though less so than above, winds extensively among wide intervales and fine terraces (all well-settled) over a drift bottom showing ledges only rarely and on one side. This character continues but with lessening drop to Tracy, where there is a small post-glacial fall at a bend of the river (the old valley being to the south) and beyond with still gentler current to Fredericton Junction, where the river turns abruptly to the northward, forming a series of post-glacial falls and rapids. The pre-glacial valley is doubtless here on the right bank, though I did not trace it. Below this the river runs into intervales and winds about among them to the Forks.

It is perfectly plain that this part of the river occupies an ancient, mature and extensive valley, the post-glacial falls at Tracy and Fredericton Junction representing only local deviations from the general course. Moreover this character extends continuously up the valley of the Yoho as far as can be seen from their junction; and since, as the maps show, the Yoho is the direct continuation in direction of this part of the valley I think there is no doubt that, morphologically, this part of the river and the Yoho occupy the same ancient valley, of which the Oromocto above the Yoho is simply a post-glacial branch.

4. *South Oromocto Lake and the South Branch.*—This part of the river I have not visited and know nothing of. Noting the direction of the lake, however, its relation to Mahood's Lake, to the small lakes northwest of it and to the head of Shin Creek, I think it is extremely probable that all of these occupy one very ancient valley, which in former times ran across the southern highlands, giving a continuous river from the Lepreau to Cranberry Lake by Lyon Stream. (See the map and that with Note 75). This connection, however, is probably long pre-glacial, and Shin Creek probably took the drainage of Lyon Stream in immediately pre-glacial times. I have seen the junction of the South Branch with Back Creek, and it enters the latter by a rather narrow valley

* Of course it is possible that there is a pre-glacial valley in this same general direction, but this seems wholly unlikely.

at an abrupt angle, showing it to be morphologically a branch of the broad ancient valley of Back Creek, and not the main stream.

5. *Back Creek and the lower part of the South Branch.*—The South Branch from the Forks to Back Creek, and Back Creek itself wind about in a continuous single, broad, mature, intervaled and terraced, obviously ancient, valley. This valley narrows towards its head, but merges gradually, without a break, into the valley of the Nerepis, which continues its direction without deviation to its junction with the St. John and beyond that through the Short Reach, Grand Bay, and South Bay. There can be no doubt, I believe, that this Back Creek—Nerepis Valley, is morphologically a single one. The question now at once arises as to its original direction of flow. This is easily answered, and in two ways. First, certain streams near the head of Back Creek have a re-entrant or southward direction,* (compare the map), and second, the general river directions of this entire region necessitate a southerly direction. This raises the question as to the original head of the valley, and here again I think the answer is fairly clear. This same valley extends up the northwest Oromocto, (cutting across the Forks near the low hills on the south) and up the Yoho River to its head. But it did not end here, for it extended, I believe, through a gap in the hills to the flat country at the source of Gardner's Creek, through Lake George and the Pokiok, and into the St. John, and this ancient and important valley we may well call from its modern remnant *The Nerepisian Valley*, the further extension and relations of which to other neighboring rivers will be found discussed in a later note (No. 75).

6. *The Main Oromocto from Forks to Mouth.*—This part of the river has at present a very uniform character. It is a deadwater creek, winding in a very broad valley through extensive intervales. In only one place, namely, just above French Lake, does it come in contact with rock-formed upland.** In conse-

* There is, however, another explanation for these re-entrant streams, namely, that in immediately pre glacial times the Nerepis headed farther west, and these were branches of it, and not of Back Creek, a point still to be investigated. For some distance north of the present divide between the two rivers, the Back Creek flows over a ledge-rock bottom, as may well be seen from the railway train. This implies that its course here is post-glacial; but this is not necessarily the case, for either a pre-glacial channel may exist on one side or the other of the present channel, or this may represent the pre-glacial summit of the rocky divide between Back Creek and Nerepis.

** This, the only case in which the river actually now touches the rocky upland, is on the right bank. In general, this river seems to keep nearer to the upland on the right than on the left, a supposition confirmed by the representation of the intervale upon the surface geology map. This tendency to keep to the right is very likely due to the well-known tendency of rivers in the northern hemisphere to erode their right faster than their left banks, due to the effect upon the moving water exerted by the earth's rotation

quence one can make out little of the geographical relations of the river from the stream itself, but an inspection of the general maps brings out some important facts. First, the streams flowing into the upper part of this section, namely, Three-Tree Creek, Mersereau Creek, Brizley Creek, are all markedly re-entrant in their main courses, indicating that at one time this part of the river flowed south, and suggesting that it was at one time a small branch of the Nerepisian River. Second, it has a large branch, the Rusagonis, entering at right angles, parallel with the St. John and in a line with Kelly's Creek and the Upper Reach of the St. John, while its direction is continued across the Oromocto by French Lake and Rockwell Stream. Though I have not been able to study this problem I think it very probable, for reasons which will be given in a later note (No. 75), that the Rusagonis and Rockwell streams persist in an ancient valley, of which the Upper Reach and part of Nacawic are parts, and which joined the present St. John at Little River in Hampstead. In this case the present Lower Oromocto was at first a small branch of the St. John, which in very early times extended back capturing the Rusagonis, and later, cutting through the divide, the remnant of which is the ridge south of French Lake, captured the branch of the Nerepisian River, and thus the main part of the river, turning it northward into its present course. The condition which allowed this extensive alteration was no doubt, as later more fully discussed, the ease of erosion in the soft sand-stones of this region, combined, perhaps, with some synclinal folding or other favoring local conditions.

The conclusions drawn from the facts here stated are of course largely tentative. I regard them as in the highest degree probable, but much study is still needed before they can be either fully confirmed or definitely disproved.

## 74.—Notes on the Physiographic Origin of the Keswick River.

Read November 3, 1903.

For some years past I have been making such observations upon the physiographic character of the Keswick valley as may be accomplished from railway trains. The method is not ideal, but the trains in that valley do not move at a rate to render such study quite impossible, especially when several trips are made to supplement one another in conjunction with the use of the best maps.

Some interesting possibilities are thus suggested, which are as follows.

The Keswick valley enters the St. John valley as a direct continuation of the latter, the two together forming a single broad, flood-plained, terrace-bordered, gentle-sloped, matured valley, while the Upper St. John enters this combined valley at an abrupt angle, in a much narrower steeper-walled and obviously newer valley. This suggests that morphologically the Keswick and the St. John valley below it are one, and that the Keswick is the morphological head of the St. John below it. Ascending, the Keswick valley retains much of its width and all of its ancient and matured appearance, the present stream, winding about amidst intervales and terraces, being obviously much smaller than that which formed it. At Jones Fork comes in a broad branch from the north; at Zealand one comes from the west; at Stone Ridge is another from the north; and another also from the north appears to come in at Upper Keswick. All the way up, the river maintains its matured appearance, though narrowing somewhat, and seemingly narrowed much more than it really is by the remarkable great terraces. At Upper Keswick the railway climbs by very steep grades (265 feet within three miles by the railway levels) out of this valley over a water-shed into the valley of the Nacawic. But as the railroad ascends, one can see finely displayed the ripe old valley of the Keswick continuing off to the northwest. Beyond this point I have not seen it, but in an earlier note (No. 50) I have suggested the probability that the north and south parts of both the Nashwaak and the Miramichi, both of which lie in a direct line north from its present source, formerly flowed through this valley, and certainly its great size strongly sustains this conclusion. I believe that these three rivers lie in a single ancient valley, with large and important branches, forming the original head of all the St. John below it, and this we may call from its modern remnant, *The Keswian Valley.* It is probable that in its lower part it had another branch, for the course of the Mactaquac on our maps strongly suggests that it formerly flowed by a small brook into the present Keswick near its mouth. Tracing now the Mactaquac valley upward, as represented on the maps, we find it lying in a line with

a branch of the Nacawic and of the Becaguimec (compare map with the next note), and even with the Presquile beyond the St. John, and it is possible that all of these lie in a single ancient valley. Certainly the curious course of the Becaguimec, which at present folds back so remarkably on itself, is in harmony with some such explanation as this, even though the present explanation may not be precisely correct in detail. If now we trace this Keswian river downward, it must have followed the present St. John valley to Jemseg, and possibly followed it to the Long Reach. There is, however, another possibility, suggested by the parallelism of this system of rivers (discussed in the next note), namely, that it originally continued from Jemseg across to Lewis Cove on the Washademoak, thence by Southwest Brook and Spraggs Brook to the Belleisle, thence across to Paticake Brook, Hammond River, Porter Brook and Quaco River to the sea at Quaco. If it really had this course, it would have been turned in very early times into its present course by the easterly erosion of branches from the lower Nerepisian and Rusiagonian valleys, as described in the preceding and in the following notes.*

## 75.—The Origin of the Fundian System of Rivers.

Read November 3, 1903.

The rivers of New Brunswick belong to three great natural systems,—one sloping southeastward into the Bay of Fundy, another sloping northeastward into the Gulf of St. Lawrence, and the third sloping northward and eastward into Bay Chaleur. Upon the first of these, which we may designate *the Fundian* system, I wish here to record some observations, looking to an explanation of the origin of its remarkable features.**

*Dr. Chalmers, in his latest Geological Report, has suggested that the St. John may once have flowed through the Nacawic and Keswick, but his explanation of the possible method differs much from that here given.

**There are many references to peculiar features, and their explanation, in the rivers of this system in the writings of the geologists who have investigated New Brunswick geology, notably those of Bailey, Matthew, Ells and Chalmers. But no attempt has hitherto been made, so far as I know, to explain the features of these rivers collectively. All physiographic study must rest upon topographical and geological data, and such studies as those here attempted are only made possible by the previous labors of these geologists who have made accurately known in its outlines and in many of its details, the structural geology of New Brunswick.

There are two very striking facts about this system, of which the explanation is not obvious. First, the courses of the rivers are in large part independent of the geological formations, for many of them, especially the westernmost, run directly across the formations, hard and soft alike. Second, the principal river of this system, the St. John, has a curious zig-zag form, with some of its parts in the prevailing southeasterly course, but others at right angles to it, and its course as a whole forms almost a semicircle around rivers west of it. All of these phenomena, I think, can now be explained, and the key to their interpretation is found in the probable physiographic history of the Oromocto, supplemented by that of the Keswick, outlined in the two preceding notes.

The general lack of correspondence between river-courses and the underlying formations can have, it would appear, but one meaning. The river valleys must be much older than the present exposure of those formations, and must have originated on a general uniform southeasterly slope which could have been formed in either one of two ways. First, this entire country was covered by level homogeneous deposits, such as the Carboniferous sandstones form in the eastern part of the Province at the present day; these became elevated from the sea with a southeasterly slope on which the rivers formed and gradually eroded their valleys down into the underlying deposits. Second, all of the formations were planed off uniformly, either by sea or river action, to a great peneplain, which, on its elevation, sloped southeast, thus establishing the parallel southeasterly valleys. Which of these two explanations is correct is not, from our present point of view, important. The great crucial point is this, that by one or the other (or possibly by some other) method, the rivers of this region were given, after all the formations were deposited, a general southeasterly course, and this they have largely retained down to the present day. Where they have deviated from the arrangement, as they have very often, it is because of the influence of the underlying formations, as will be shown later in this paper.

So far as I have been able to work out the original valleys of this system, they are as given below. The descriptions can be

followed in general upon the accompanying small-scaled map, but they will be much plainer if read in comparison with the maps of the Geological Survey, which show also the courses of the formations.

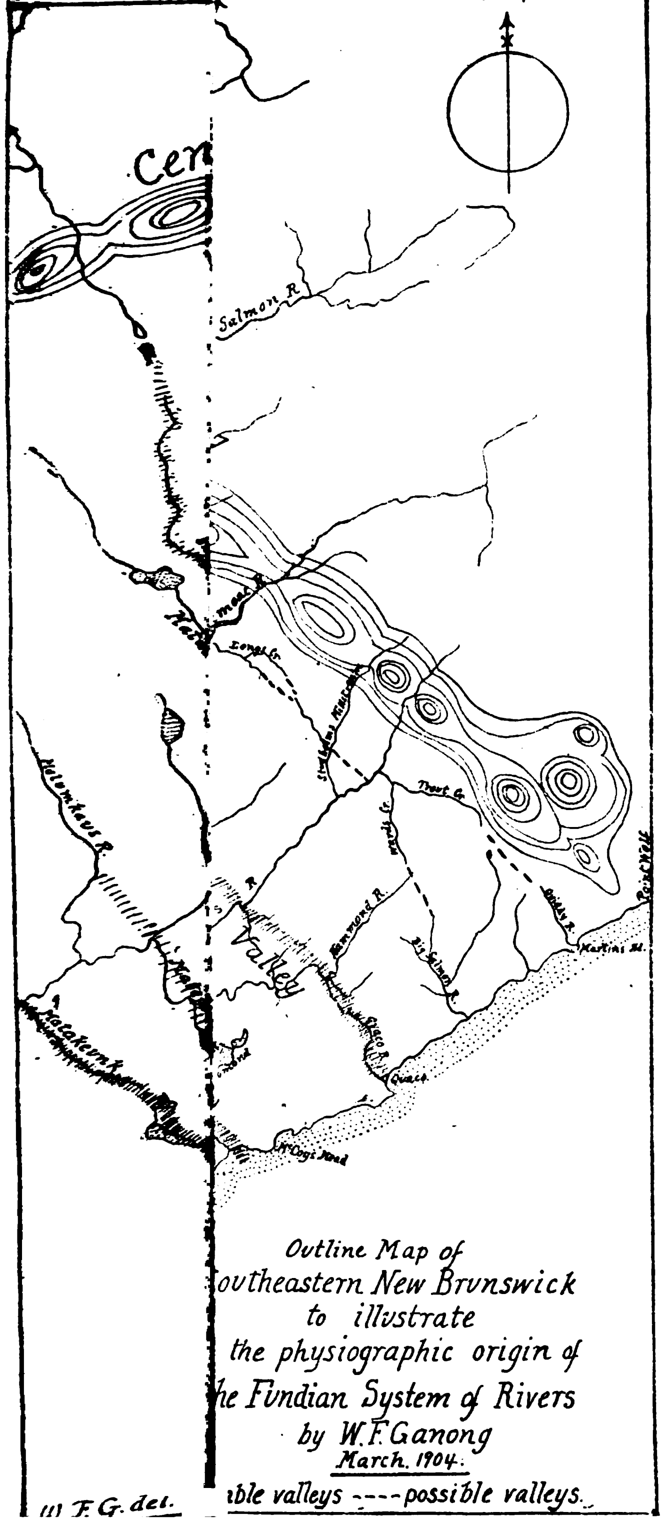
1. *The Machian Valley.*—To the westward of the New Brunswick series lie lines of valleys strongly suggestive of a continuation of the system. The westernmost of these heads in the East Branch of Penobscot (outside the limits of the accompanying map, but very plain on Wilkinson's map), follows the Penobscot a short distance to the re-entrant Matakeunk, which it follows through the westernmost Scoodic lakes to the Machias.

Possibly another occurs east of this, heading in the Molumkaus, crossing through Matagoodus, Scoodic Lakes and East Machias.

2. *The Scoodian Valley.*—This is the least distinct of the valleys of the region, but it appears to be traceable from the Baskahegan along the streams to the Grand Falls of St. Croix, thence following the present river (the ancient Scoodic) to near Meddybemps Lake, whence it probably runs through the Penamaquan Valley into Cobscook. But my evidence as to this valley is almost wholly cartographical, and I can offer little more than a suggestion. A minor valley seems to be east of this, including Mohannes Stream, Magurrewock and Boyden's Lakes.

3. *The Chepednian Valley.*—This appears to head in Matawamkeag River, or Skitticook Branch, (if not farther north in Aroostook waters), and extending through Grand Lake and its Great South Bay, Lambert Lake, Scott's Brook, the Chiputneticook (St. Croix) to Canoose, runs thence across to Denys River, and by this to the St. Croix below St. Stephen, which it follows to near the Narrows, when it passes behind the Devil's Head to reach the lower St. Croix near Red Beach.

4. *The Passamaquodian Valley.*—This valley appears to head in the south branch of Meduxnekeag (and perhaps farther north), extends thence to Lower Monument Brook, thence across the head of Pirate Brook to Musquash Brook, thence directly through to the St. Croix, which it leaves at Mud Lake, whence it extends across the heads of Canoose and Denys streams, Gallop Stream, and thus into Oak Bay and the Lower St. Croix (both of which it formed); it continues through Passamaquoddy near the Maine shore, passes between Deer Island and Moose Island, and crosses Campobello to empty through Herring Cove. A large river having this general course explains perfectly the origin of the remarkable Oak Bay-St. Croix estuary, which otherwise stands much in need of interpretation.


Cen
Salmon R.
Trout Cr.
Hammond R.
Big Salmon R.
Quaco
Martins Hd.
Point Wolf
Valley
Outline Map of
outheastern New Brunswick
to illustrate
the physiographic origin of
he Fundian System of Rivers
by W. F. Ganong
March. 1904.
ible valleys ----possible valleys.
W. F. G. del.

There is perhaps a minor valley east of this, including possibly some of the west branch Digdeguash and Upper Waweig, which emptied through Bocabec Bay and Letite Passage, forming the latter.

5. *The Digdeguasian Valley.*—This appears to arise as far north as Bull's Creek (perhaps even in branches of Mednuxnakeag), includes the Upper Eel River, the three Eel River lakes, La Coote Lake, the Digdeguash lakes (or possibly as on the dotted line of the map), thence to the Digdeguash itself, whose course it follows with perhaps a branch from Bolton Brook to near its present mouth, where it may have emptied by Letite Passage, or it may have crossed in part by the small streams shown on the maps, to Letang, forming the deep entrance to that harbor.

6. *The Magadavian Valley.*—The lower course of this river is fairly clear, but two possible branches may be traced at its head with two others lower down. One branch may have originated north of Eel River, in Pokomoonshine Brook, following Eel River to Pocowagamis Brook, Skiff Lake, Grassy Lake and Upper Cranberry Brook to Upper Trout Brook and the Magaguadavic. A second branch seems to have included Eel River below Benton* (and possibly the brook through Spearville and even Bull's Creek above Debec) through Pine Swamp Brook to Sheogomoc waters, (following the railroad at Canterbury), through second Sheogomoc Lake, Big Duck Lake, Duck Brook across Magaguadavic Lake and along the present Magaguadavic (or a stream west of it to Davis Brook) and by the present Magaguadavic to near Brook of Sticks, where it may have crossed through the low ground into Kedron, and by Kedron Brook to the Magaguadavic. (Compare Note 73, and its map of Oromocto Lake) Or it may even have crossed through the small gap in the ridge west of Oromocto Lake, across the lake to Kedron waters, as shown by the dotted line on the map. The third branch probably originated in Charlie Lake (and perhaps farther north in a part of the St. John and Bull's Creek), thence running to first Sheogomoc Lake, thence to Little Magaguadavic Lake, thence through the gap between Blaney and Magaguadavic Ridges, through Deadwater Brook into the head of Oromocto Lake, through that lake into Kedron and thence into the Magaguadavic. A fourth, and very minor, branch perhaps originated northeast of Oromocto Lake, flowed southeast through Little Lake and Peltoma thence into Piskehegan and the Magaguadavic. The deviation of the two latter branches to the

*It seems possible that Eel River had a former, perhaps immediately pre-glacial, outlet from Benton eastward along the general course of the present highway and the old Indian portage.

westward is of course caused by the great granite mass of Mount Pleasant, rising 1200 feet, which as this deviation of the rivers would show, stood out as a monadnock from the plain on which the rivers formed. The lower Magaguadavic below Piskahegan appears to run in its ancient valley to Red Rock, whence it pretty certainly continues through Red Rock, Sparks and Clear lakes to Forked Lake (between the two latter lakes there is a remarkable valley that I have myself seen), thence into Popelogan and Popelogan Harbor. The Magaguadavic below Red Rock appears to belong to Bonny River and Clarence Brook.*

7. *The Leproian Valley.*—As mentioned in Note 73 it appears possible that a valley originated in the Cranberry Lake basin, flowed through the gap at Harvey into Lyon Stream, thence by Otter Brook, the head of Shin Creek and its south branch, to South Oromocto Lake, Mahood's Lake and into the Lepreau, which probably emptied on the coast at or near Little Dipper Harbor, or else at Musquash. This country is now so elevated, the lake surfaces lying nearly 600 feet above sea-level, that this river must been turned from its course at a comparatively early time, and Shin Creek would appear to be the modern successor of the early stream which took this direction.

8. *The Nerepisian Valley.*—As described in Note 73 I have traced this ancient valley on the ground through much of its course. Its source is uncertain, but most probably, I think, is in the Meduxnekeag, whence it crossed in a line through the heads of several small streams to the Pokiok, (although it may have followed the present upper St. John). From the Pokiok it extends southward across the head of Gardens Stream to the Yoho, the Oromocto, Back Creek, the Nerepis, the Short Reach, Grand Bay, and to the sea in or near St. John harbor. At this early period the upper St. John, above the central watershed, either did not exist or else flowed to Bay Chaleur, a subject later to be considered.**

9. *The Rusagonian Valley.*—As suggested in Note 73, this appears to represent another of the parallel valleys. It headed in some branch of Nacawic, and very likely in the Little Presquile beyond the St. John, (the Little Presquile would seem, from the

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* Or possibly the Didgeguash flowed through Digdeguash Lake, and by its lower end to the Magaguadavic, the Canal, Lake Utopia, head of Letang and Beaver Harbor, as shown by dotted line on the map.

** All physiographic evidence, of which I have collected much, later to be presented, tends to show that this present central watershed separating the Tobique from the Miramichi is also the ancient one. This is in marked contrast with the eastern water-shed, which has shifted from its ancient position and moved farther to the eastward.

maps, to have had an earlier outlet, in the line of its general direction, through a little brook now flowing southeast into the St. John); and followed the Upper Reach, Kelly's Creek, the Rusagonis, and Rockwell Stream. Beyond this I have found no direct evidence of its course, but the general parallelism with other rivers would lead us to expect that it crossed to near Little River in Hampstead and followed the St. John to the Belleisle (originating this part of the St. John). It ran thence through Kingston Creek, Forester's Cove, and a line of brooks to Loch Lomond, Black River and the sea west of McCoy's Head. Such a course explains perfectly several otherwise puzzling geographical features, such as the course of the St. John from Long Island to the Belleisle, and Kingston Creek. The deviation from parallelism at Little River is of course explained by the presence of the great Bald (or Champlain) mountain mass, which would thus be shown to have stood up like Mount Pleasant, as a monadnock from the general plain on which the rivers were forming.

10. *The Keswian Valley.*—As described in the preceding note, this river probably headed in the Miramichi, flowed through the Upper Nashwaak (with a branch from the source of the Miramichi and a part of Becaguimec, and possibly from the upper St. John), the present Keswick and the St. John to Fredericton receiving an important branch from the Nacawic, Upper Becaguimec (and perhaps the Presquile); thence its course was probably along the present Portobello under the intervale to Major's Island and the present river to Jemseg.* From this point it seems possible that we can trace it also across country to the sea through Lewis' Cove, Spragg's Brook, Paticake Brook, part of Hammond River, and Quaco River, to the sea in Quaco Bay.

It is possible that even another of these parallel valleys existed east of the Keswian along the course of the dotted line on the map. If so, it arose in the Nashwaak above the Udenack (perhaps even in Miramichi Lake and north of the Miramichi), passed through Udenack and McKenzie Brook (or as on the map) across the head of Little River, over Grand Lake to Young's Cove, over Washademoak to Long's Creek, thence to a branch of Studholm Mill Stream, to Sussex Vale, and by Trout Creek and Quiddy

*Below Fredericton there begins an extensive intervale basin which soon opens to include Portobello, French Lake and Maquapit; and it is noteworthy that the St. John for the most part keeps close to the upland on the southwest. It is possible that this is a result of the tendency in rivers of the northern hemisphere to erode their right banks, a consequence of the influence of the earth's rotation on the moving water. Something of the same kind appears to be true of the Lower Oromocto, (Note 73.)

River, or else by Wards Creek and Big Salmon River to the sea. Such a river should be named from its only important existant part the *Nashwian River.* But I have no evidence for it other than cartographical.

Somewhere east of this river, and parallel with it, must have come the ancient water-shed between this Fundian System and the St. Lawrence System. This water-shed I believe we can still trace in its remnants, constituting the elevated land near Point Wolfe, extending thence to the lofty hills of Sussex and across the Washademoak to Marrs Settlement hill, across the head of Grand Lake, Emigrant Settlement hill, between Salmon Creek and Newcastle Creek, thence to the water-shed between the Taxes and the Nashwaak, and beyond to cross the Miramichi, as shown on the map. There is evidence to show, which will later be presented, that originally all waters west of this line were branches of the Keswian (or Nashwian) while all east of it flowed into the St. Lawrence.*

One important fact about all of these rivers remains to be mentioned, namely, it is possible that at the time of their formation the Bay of Fundy was rock-filled, and these rivers flowed across Nova Scotia into the sea (just as those of the St. Lawrence system flowed over Prince Edward Island, and those of our northern system flowed across the Restigouche valley into the St. Lawrence), thus originating the valleys which cross that Province from northwest to southeast. It may even prove possible to identify the corresponding valleys in the two Provinces (thus determining, for instance, which valley formed Annapolis Gut, which emptied through Mahone Bay, etc.), although on the Fundy slope the Nova Scotia rivers are much modified.

Such appears to me to have been the original arrangement of river valleys in this region. I have no doubt that further research will modify the conclusions in many details, but the general principles I believe are correct and will stand.

We must consider now the causes of the profound modifications of the original arrangement which have given us the very different conditions of the present. According to our theory,

* As I have pointed out in an earlier note, No. 49, footnote.

these valleys originated on a southeasterly sloping surface as it arose from the sea. Had the underlying rocks been uniform in texture and hardness, those rivers would doubtless have kept those courses to the present day. But the rocks were not of equal hardness, but on the contrary consisted of bands of harder and softer rocks running for the most part directly across the courses of these rivers. In the process of erosion these softer bands were cut down rapidly, forming large right-angled branches to the older valleys. Ultimately these branches were able to cut back into neighboring valleys and frequently to capture their head waters. It is in this erosion by branches of the main valleys along the softer rocks crossing from valley to valley that we have the explanation of the changes which have altered the original arrangement to the conditions that we find at the present day, for all of the river courses of this system seem to lie either in the ancient northwest and southeast valleys across the rock bands, or in northeast and southwest valleys following the general direction of the softer rocks.

Turning to these cross valleys, we note that by far the most important of them is the Oromocto, which lies near the middle of the broadest of the bands of the soft Carboniferous sandstones. Starting as a small branch of the Keswian River (which itself, running across a greater extent of soft rocks that any of the rivers to the westward, cut its channel more rapidly than they, thus becoming a sort of trunk river), it cut backward into the Rusagonian valley, capturing its upper part. It is precisely because this valley was the first thus to be captured that it is now the least distinct of them all (especially east of its captor). The Oromocto then extended farther back capturing a branch of the Nerepisian valley. Similarly, but somewhat later, a branch of the Nerepisian, eroding backward (along the present Shin Creek), captured the Upper Leproian, but the final capture of two branches of the Magadavian was only effected (as Note 73 shows) by aid of the glacial period. Meanwhile, and very early in this series of changes, certain bands of soft rocks occupying the present Belleisle-Long Reach and Kennebecasis valleys (their presence there being due to earlier geological causes worked out by our geologists)

were gradually cut out by backwardly extending branches from the lower Nerepisian, which thus very early captured the lower Rusagonian, and soon after the lower Keswian (whence the lower courses of these rivers have had time to be much altered by minor later changes), while a branch of the lower Rusagonian early extended back and captured the Keswian, forming the present St. John from the foot of Long Island to Jemseg. It was no doubt a similar erosion which formed the great Hammond River-Loch Lomond-Little River valley, and another of analogous character which formed the northeasterly part of the Nerepis River.

In the meantime, also, a branch parallel with the Oromocto was eroded back from the Keswian near the mouth of the present Keswick, to capture the Rusagonian at Kelly's Creek.* It is true this part of the river does not now run in the softer Carboniferous rocks, but remnants of those rocks exist, showing that it formerly did so. The erosion of this band did not stop here, however, but extended along upper Gardens Creek. It was very probably a similar erosion starting in bands of soft rocks now removed which formed the northeast branch of Nacawic and the St. John thence to Pokiok, thus capturing upper Nerepisian waters. Something of the same kind would explain the northeast and southwest parts of Eel River (and even the course of the main Matawamkeg beyond). During this time also the great branches of the Keswian were eroding eastward, originating the Washademoak, Grand Lake, Little River and the Nashwaak, a regular radiating series, capturing in early times for the great Keswian the old Nashwian, if that really existed. We can trace also similar effects on the other rivers. Thus it was probably a similar erosion which formed the Magaguadavic northeast of Trout Brook, turning one branch of this valley into another. Such an erosion northeast from the Chepednian valley also probably formed the St. Croix from Mud Lake to Scott's Brook (and Trout Brook beyond), thus early capturing the upper Passama-

*Professor Bailey gives evidence to show that this part of the river occupies a channel dating back to pre-Carboniferous times, which makes its explanation all the simpler. (On the Physical and Geological History of the St. John River, New Brunswick. Trans. Royal Soc. Canada, I, 1883, iv, 283).

quodian. Another similar erosion from the Scoodian at Grand Falls formed the St Croix east to the Canoose (and that river), capturing the Chepednian, while to the westward it formed the Scoodic Lake valley. Changes of a similar general character seemed to have turned the lower Scoodian and the lower Chepednian into the lower Passamaquodian, while others turned the Magadavian into the valley of Bonny River and formed the lower Lake Utopia and lower Magaguadavic, the Latang and its extension between Deer Island and Campobello, Lepreau harbor with its extension northwest of the Wolves and between Campoello and Grand Manan. Of course these erosions may have been and doubtless were, aided by other causes, such as earth movements ( synclinal ), fault lines, etc., and some of the minor ones may even be of glacial origin only, but all of these influences are really more or less connected, and lateral erosion seems to have been without doubt the leading factor.

The zig-zag form of the present St. John (and of the St. Croix, though much less in degree,) is thus in great part explained. Its semi-circular course around the other rivers (shared in much lesser degree and in the opposite direction by the St. Croix) is due in a broad way to a combination of the tendencies of the waters to continue on their direct courses with the tendency to more rapid erosion in the softer rocks, which together carry the rivers around the margin, as it were, of the hardest and hence more elevated region occupied by the enclosed rivers, Thus gradually was a condition approximating that of the present brought about. The final details were added *first,* by the glacial period, which produced many minor modifications (including perhaps the turning of some streams to the southward), and *second,* by an extensive subsidence which has carried the lower courses of these valleys beneath the sea. The course of events here related is largely independent of any theories of peneplains, etc., but the facts in general are in harmony with the theory of the two peneplains, earlier discussed (Note No. 49), of which New Brunswick appears to be made up. There is here opened up a most attractive field of investigation in the working out of the subject in detail.

## 76.—On New Aneroid Measurements in New Brunswick in 1903.

Read December 1, 1903

During July, August and September, 1903, I made a number of aneroid measurements of the heights of places in the Province, mostly hitherto unmeasured, with the results below. The instruments and methods were identical with those earlier employed. as recorded in Notes Nos. 53 and 62. I may repeat the opinion earlier expressed, that the results thus obtained are as accurate as can possibly be secured with aneroid barometers under New Brunswick conditions. A few measurements made on the Oromocto are recorded in my note on that river (No. 73) ; I shall here consider only those made in the Tobique-Nepisiguit region.

In Note No. 62, I called attention to the fact that all heights checked from the Chatham base averaged lower than when checked from the Fredericton base, and that the figures show an average difference between the two stations of about thirty-two feet, which ought not to exist. As I had found reason to consider the Fredericton station as without sensible error, I attributed the discrepancy to some peculiarity in the methods or instruments of the Chatham station. I find the same difference this year, though larger in amount, reaching thirty-eight feet, but I have also discovered the explanation in part. A comparison of certain figures shown me by Mr. D. L. Hutchinson with the daily weather maps, suggested that there was a real difference in the average prevailing barometric pressure, independent of elevation, of the two stations, and this is confirmed by the pressure maps published in the latest Report of the Chief of the United States Weather Bureau, which show that the average barometric sea-level pressure through the year is less at Chatham than at Fredericton. The average difference, however, in August, according to the latter map, is not over .0125 of an inch, which answers to about ten feet, leaving a discrepancy of about twenty-five feet to be accounted for in some other way, a subject which deserves investigation. The practical question now arises as to the value to be given the readings of the two stations respectively, in determining the altitudes. Since all of the more important measurements were made

on the South Branch Nepisiguit, which is north of Chatham, and since the lines of equal pressure in August run east and west, it would seem to be fair to give full value to those of Chatham, and ignore those of Fredericton; but since it seems clear that there is still a discrepancy not accounted for by the average pressure-difference of the two stations, and since I have cause to think, for reasons given in Note 62, that the Fredericton station is free from this discrepancy, I think it will be fair to give to the control from the Chatham station twice the value of that from Fredericton, and this has accordingly been done in all the following measurements. All figures in italic are heights above mean sea level, and all of the various places in the vicinity of the South Branch are shown on the map accompanying Note 77.

Mount Bailey (Nictor Lake). Adopted height of the lake 850; northwest peak 600 feet above lake, hence *1450*; south peak, 1125 feet over the lake, hence *1975*; east peak, 920 feet over lake, and hence *1770* feet above the sea.

Paradise Pond. (See Note 77 and map). Mean of nine good measurements checked from Fredericton 1251, from Chatham 1221; hence by the above rule the height is about *1230*.

Chief's Mountain. 960 feet over Paradise Pond; hence 2190 feet above the sea. Two measurements checked from Fredericton gave 2236 feet, and from Chatham 2181; these would give, by the rule above, 2199. Averaging this with the direct measurement of 2190, we may accept *2195*.

Scudon Mountain. 830 feet over Paradise Pond, and hence *2060*.

Acquin Mountain. 70 feet under Chief's, and hence *2125*.

Hannay Mountain. 909 feet over Paradise Pond; and hence *2139*.

Fisher Mountain. 895 feet over Paradise Pond; hence *2125*.

Raymond Mountain. 985 feet over Paradise Pond; hence 2215. One measurement compared with Fredericton gave 2184, with Chatham 2181; hence 2182. Averaging this with the direct measurement we have *2198*.

First Forks river surface. One measurement from Fredericton, 1396, from Chatham, 1347; hence by the rule *1363*.

Elizabeth Mountain. 790 feet above the First Forks, and hence 2153 feet. One measurement checked from Fredericton, 2174; from Chatham, 2140; hence by the rule, 2151. Averaging this with the direct measurement, *2152*.

Bald, or Kagoot Mountain (near source of South Branch; fully discussed in Note 72). Mean of five good measurements checked from Fredericton, 2351 feet; from Chatham, 2259;* hence by the rule, *2290*.

Middle Mountain. 120 feet lower; hence *2170*.

Caribou Mountain. 220 feet lower than Big Bald; hence *2070*.

South Branch Nepisiguit, immediately south of Big Bald. 585 feet below Big Bald; hence *1705*.

South Branch Nepisiguit, just south of the Notch. Two measurements checked from Fredericton, 1640; from Chatham, 1575; hence by the rule *1597*. The deadwater just west of Big Bald is probably about *1675*.

Source of the Northwest Miramichi. (See Note 77). One measurement checked from Fredericton gave 1351; from Chatham, 1331; hence by the rule *1338*.

Northwest Miramichi just south of Mount Cartier. Two measurements checked from Fredericton, 1164 feet; from Chatham, 1167 (sic); hence *1165*.

Mount Cartier, or Little Bald. 960 feet over the Northwest south of it; hence 2125 feet. Two measurements checked from Chatham, 2226; from Fredericton, 2174 (sic); hence by the rule, 2212. Averaging this with the direct measurement, *2168*. This mountain, however, is apparently higher than Chief's and any others in the vicinity, and I am inclined to think there is some error in my measurements and that it really is considerably over 2200 feet.**

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*The great difference between these figures suggests some error in my figuring, but comparison of the readings of Fredericton and Chatham at those times shows that the difference really exists in the readings of the two stations.

**Nothing, however, can possibly be more deceptive than the apparent heights of mountains viewed from others at a distance, for the eye invariably judges the height according to the distance it rises above its neighbors. Hence a mountain really not very high may seem of great elevation when isolated among lower hills; and this is the case with Little Bald or Cartier. Again, a mountain really of great height, if rising little above its neighbors, may be thought not to be so; this is the case with Carleton, highest in the Province. There is one thing which makes me think Cartier may really be little or no higher than Chiefs, despite its much greater apparent height, namely, in a photograph of it from Chiefs it stands up very little above the horizon beyond. As the land to the eastward is certainly of lower elevation, this implies that Cartier cannot greatly surpass Chiefs in height.

## 77.—On the Physiography of the South Branch Nepisiguit.

Read December 1, 1903.

One of the least known of all the wilderness parts of New Brunswick is that drained by the South Branch Nepisiguit. This is because that stream is practically not navigable for canoes from its mouth, while it is extremely difficult of access from any other direction. In August last (1903), in company with my friend, Professor A. H. Pierce, I traversed this stream from its mouth to beyond Bald Mountain near its source. The observations, and some surveys then made, are recorded upon the accompanying map and in the notes below.

The development of knowledge of the river may be briefly traced. It appears first upon the remarkable Franquelin-de Meulles map of 1686, with the name *Attououik*.* It then vanishes from all records, until its mouth is located upon Peters' Plan of the Nepisiguit of 1832, and in 1837 it was surveyed for some fifteen miles by Berton, whose plan, with the addition of a few incorrectly located mountains, was first used on a printed map by Wilkinson in 1859. This was followed by Loggie in 1884, with the addition of Bald and some neighboring mountains, taken from an incorrect plan of 1882 by Freeze, who approached it from the south while surveying timber lines. A great improvement over this map was made in the Geological Survey map of 1887 (or 1888), which embodied the observations of Ells, who was in this region in 1880, and despite its fanciful and erroneous hashure topography, this map has remained the best down to the present.

* This map is in Trans. Royal Soc. Canada, III, 1897, ii, 364. On this map the Little South Branch appears as *Kagout*, or *Kagoot*. But as the Micmacs of to-day call the Main or Lower South Branch *Kagikqu*, or as Rev. Father Pacifique writes me *Gagigo*; as Rand would write it, *Kagikkw*; and the Little South Branch, *Paatkunok*, as Father Pacifique gives it *Patganog*; *Paatkunok*, as Rand would write it, I infer that deMeulles has accidentally transposed these names. Since the Micmac name of this river ought to be preserved, and since the very numerous Bald Mountains of the Province ought to be given at least alternative names, I propose that the Micmac name of the South Branch, in its ancient and simple form used by deMeulles, *Kagoot*, be applied to this mountain.

It is reproduced, though somewhat crudely, in the accompanying cut, which is one-half the size of the original, and which covers the same area as our larger new map illustrating this note. A later sketch of the river in Whitehead's sportsman's map, 1902, adds some lakes at the heads of its western branches.

References to the basin in scientific or other literature appear to be extremely few. The earliest I have found is the mention in Dashwood's "Chiploquorgan," (1871), of a hunting journey he made on foot in 1863 from the mouth of this branch to the head of the Sevogle, apparently along the stream, and he appears to have ascended Bald Mountain and to have gone thence to Kewadu Lake. The next record of a visit is by Ells, in his Geological Report, 1879-80, who gives an account of the geology, and some description of the topography of the region. His report does not made it clear by what route he traversed the country, but he has been so kind as to write me that he went on foot with a hunter from Forty-two Mile Brook via the Northwest Miramichi and Kewadu Lake to Bald Mountain, and thence along the South Branch to its mouth, whence he returned to the head of the Norwest, and thence by Little Bald (Cartier) to Nepisiguit. The only published references to the region since that time appear to consist in a mention in the *University Monthly* for November, 1898, of a visit of some surveyors to Bald Mountain, and an account of the killing of a big caribou on Bald (our Kagoot) Mountain by James Turnbull, in *Recreation* for March, 1899. A number of sportsmen have visited the Bald Mountain district, guided by Mr. A. Pringle, who has a hunting camp at the foot of this mountain (the only human work in the South Branch basin), and a trail thence, as shown on the accompanying map, to the Northwest Miramichi. I can learn of no one who has ascended the lower course of the South Branch by canoe, and it is probable that our canoe trip up its lower ten miles last August was one of the first ascents of it made by white men, and doubtless it was the first by amateurs without guides.* Very little

* We dragged our canoe and load up for some ten miles (a mile or two above the Second Forks) and went the remainder of the distance on foot; afterwards we carried over from near Paradise Pond into the source of the Northwest, and descended that river to Newcastle.


Valley
Minto Br.
Des Ba

lumbering on the river has been done, though some twelve years ago some lumber was driven down it by Lovell Bros., of Bathurst.

The South Branch Nepisiguit is remarkable for three things: its curiously gradual transition from a deadwater near its source to the roughest river of the Province near its mouth; its remarkable hills; and its surprising relations to other rivers. These we shall consider in order.

The river rises in three heads on the northern margin of the great central watershed, one branch coming from the west, another from the south, and another from the east. These streams unite in a great open basin west of Bald Mountain and wander for some two miles through deadwaters and small ponds in bogs and alder swamps. Flowing northward the river then begins to fall, at first gently, and then more swiftly, forming one of the most charming of New Brunswick streams, winding over gravel between wooded banks, much as does the Little Tobique or Upper Nepisiguit. Farther north the basin narrows rapidly by the approach of the forested hills, until the river runs in a narrow winding notch between steep forested hills, with an increasingly swift current over cobbles and small boulders. Issuing from the Notch it flows more swiftly* over boulders between lofty naked hills, and it receives two streams from the westward, after which it makes a big bend to the eastward. It now becomes so swift and broken by rapids and falls among boulders that for the next two miles it is navigable for canoes only with very great difficulty. Near the end of this easterly stretch lies a large pool or pond (Paradise Pond), with charming surroundings, the only quiet waters on the whole lower river, and in this pond are trout of so

*The accompanying map, unfortunately, does not show this winding character of the valley through the Notch, and it fails also to show the similar winding of the rocky valley below Paradise Pond. This is because I depended upon Berton's plan for the river to south of the Notch, and I did not discover until too late to make surveys that the map is seriously inaccurate in both of these parts, representing as it does the general course of the stream as straight when it is very winding. I have preferred to follow his plan on this map rather than to attempt to put in the winding from memory.

Ells' description of the stream above the Forks is not strictly correct, or at least is misleading. He says (Report 2): "From the frequency of its falls and rapids, it lower part for about six miles is difficult for canoes, but above this point no such obstacles exist;" again, (34) "above which [the forks, 7 miles from the mouth] the stream for some fourteen miles winds through a low and swampy hollow between high mountain ranges." As a matter of fact the canoeing is difficult for some miles above the Forks, though steadily improving as one ascends, and it only becomes really easy south of the Notch.

wondrous size, beauty, number and voracity that a man doth danger his name for truth if he but tell the fact concerning them. Below Paradise Pond the river again swings to the north, and cuts its narrow valley still deeper (about a thousand feet), between the great bare rocky hills, and from this point to its mouth it is little better than a bouldery torrent, almost unnavigable for canoes, and the swiftest river in New Brunswick. In places the valley becomes so narrow, and its walls so steep, that great masses of granite have fallen into the stream, making falls and rapids of the roughest character, necessitating many portages by the voyager. Finally it enters the valley of the Nepisiguit, which it joins quietly in a great basin. The scenery of this part of the river has been well described by Ells, though with some exaggeration as to the vertical bluffs: "immense mountains, whose white weathering bald sides, often terminating in vertical bluffs of several hundreds of feet, flanked by huge heaps of debris, present prominent features of the landscape. The scenery is among the grandest in the province. Huge hills extend as far as the eye can reach. These are often burnt completely bare, and the mountain rock is entirely denuded of soil; at others small clumps of green woods break the sterile aspect of the country, and indicate the course of some small stream." (Report 33 D). Whether hills are seen from the valley, or the valley from the hills, the aspect is the grandest and roughest to be seen in New Brunswick. The view along this deep rocky valley from Hannay Mountain towards the Nepisiguit, with the basin of that river in the distance, comes the nearest to a genuine mountain view that I have seen anywhere in this Province. So rough is the river that its roar can be heard far back upon the hills, where it forms the most characteristic sound of the region.

The great descent of the river is made more apparent from the levels taken by us with the aneroid at several points. The sources of the river must lie at about 1.800 feet above the sea, for we found the elevation of the river in the vicinity of Bald (Kagoot) Mountain to be 1,705 feet (Note 75). Just south of the Notch we found it to be 1,597 feet, while at the Forks, near Pierce Mountain, it was 1,363 feet. At Paradise Pond it is 1,230 feet; hence the drop in the two miles from the Forks to Paradise

Pond was sixty-one feet a mile. Now the mouth of the river is about 860 feet above the sea (for I estimate it is about fifteen feet below the mouth of Portage Brook,* two miles above), and hence the drop in the lower five miles is seventy-four feet per mile (in some of the miles much more), a greater drop than any other five miles of river in New Brunswick possesses, exclusive, of course, of the vertical drop of lofty falls.

A very notable fact about the river throughout its course is this, that it invariably runs over drift. Ledges in places form the valley walls, and the river washes against them, but not once in its entire course is the valley bottomed by ledges, and the falls are invariably over and among boulders. Moreover, in most places along the river there are distinct boulder terraces, and these are very well marked even in the narrowest part of the lower valley. These facts show conclusively that no part of this river is post-glacial, but that it all flows throughout its course in a pre-glacial valley.

We consider now the mountains of the South Branch, and first note those about its source. Those from among which the three heads of the river descend are somewhat over 2,000 feet above the sea, of gentle contours, and forested. They form a part of the great central watershed of the Province, a remnant of an ancient peneplain which extends both southwest and northeast, as will presently be described. By far the most conspicuous one among them is Bald (also called Big Bald, our Kagoot), hitherto supposed, but erroneously (as I have shown in a previous note, No. 72) to be the highest in New Brunswick, which owes its prominence not to its height, which is 2,290 feet, and but little greater than that of its neighbors, nor even to its elevation above the basin of the South Branch, for it is only about 600 feet above the river at its base, but to a combination of complete and striking bareness, with partial isolation and a bold outline. The view from its summit is fine, but is neither so extensive nor so striking as that from several other mountains in the Province. To the east and south the country is a great featureless plateau, as it is also, though with a little more irregularity, to the southwest and west. To the northwest in the distance the country is much broken,

*875 feet. Note 62.

for here are seen those irregular hills carved from the original peneplain by the numerous streams about the sources of the Nepisiguit and Tobique. To the north one sees the great open valley of the South Branch narrowing to its notch in the northward, and east of that the great wooded dome (higher than Kagoot) which connects this mountain with Raymond and the neighboring mountains to the northward, all of them together forming a single great plateau. To the northeast are the broken hills of the source of the Northwest, and nearer lie the two lakes, Spruce and Kewadu, apparently in ancient north and south depressions. Immediately to the southward extends an outlier of this mountain (Middle Mountain) also bald, and beyond that, across the stream, is another bald summit (Caribou Mountain) some 220 feet lower than Bald.

The summit of Bald Mountain is of granite, which has weathered into several curious boulder-like masses, of which two are very prominent on the summit. Its slopes are covered with a close growth of heath bushes and lichens, mostly very easy to travel over, and intersected everywhere by caribou trails.* Immediately south of the mountain, in the valley of the South Branch, occurs one of the most interesting and attractive associations of vegetation I have seen anywhere in New Brunswick. Very symmetrical, completely cone-shaped black spruces grow scattered in a park-like fashion over a close vari-colored carpet of reindeer moss, dwarf blueberries, mayflowers, and other small heaths, while the park-like aspect is increased by the numerous caribou paths winding here and there among the trees.

Northward of Bald Mountain to beyond the Notch all of the mountains are heavily forested, but about the Second Forks the open burnt country begins and continues to the Nepisiguit. This country, very probably the most extensive open tract in the Province, must have been burnt a long time ago, for all traces of fire, except the bareness, have vanished. The country is very slowly reforesting itself, forming first the usual barren vegetation of lichens and heaths, and upon the turf thus formed there comes in

* On the slopes of these mountains, and also on the open plateaus, occurs an abundance of the Dwarf Birch, *Betula glandulosa*, a plant which appears not to have been reported hitherto from the Province.

the Scrub (or Gray or Banksian) pine (Pinus Banksiana), which is now the most characteristic tree of this open country. Their openness makes these hills very easy to climb and travel over, while they afford suberb views, most charming in themselves and illuminating as to the topography of the region. For the most part, the hills are not isolated, but form summits, more or less distinct, of great plateaus, separated from one another by deep valleys. Of these plateaus, four are distinctly recognizable north of the Notch. First, there is a great wooded plateau (the DesBarres Plateau) west of the Forks, the culminating points of which are the conical Mount DesBarres (named by me in 1898, Note 30), and a gently rising somewhat higher dome south of it. But this group I have not studied, and hence I have not brought it within the limits of the accompanying map. The somewhat isolated Pierce Mountain, west of the First Forks, is an outlying part of it. North of this, however, comes a fine great plateau, *Marie Plateau,* partially wooded, bounded by the South Branch, by the Main Nepisiguit, and by the fine Nictorian valley, to be described below (see the map). The culminating point of this plateau is the great ridge, the northern end of which I have earlier named Mount Marie (Note 30). East of Mount Marie this plateau exhibits some seven distinct peaks, of which one, Mount Elizabeth, (2,152 feet) immediately north of the First Forks, is by far the most important, for it is so elevated and so fortunate in situation that it commands one of the best views in all New Brunswick. From its summit all the important mountains of North Central New Brunswick (as the view-circle on the map but imperfectly indicates), can be seen, and it gives also an admirable view of the topography of this part of the country.

The third great plateau is that named on the map the *Historians Plateau.* It is perfectly continuous with Bald Mountain, and is bounded by the South Branch on the south, west and north, and on the east by the Upsalquitchian valley and the head of the Northwest Miramichi, and by what appears to be a very ancient but shallow valley extending thence southward, and including Spruce Lake.* At its northern end rises the extremely rugged rocky bare summit, Hannay Mountain (2,139 feet); south of it

* Kewadu appears to lie in another shallow parallel valley more to the eastward.

comes another of less prominence, Fisher (2,125 feet), and south of that a well-rounded summit, less conspicuous than Hannay, but really loftier and of wider outlook, Raymond Mountain, (2,198 feet). On the eastern flank of this range, and partially detached, is a lower hill, Murdoch Mountain. Beyond that the plateau appears to rise still higher in several rounded wooded summits, to be named for students of the future, and of which the highest should bear the name Historians Mountain.

The fourth plateau, Chiefs Plateau, is the most striking and important of them all. It is bounded by the South Branch, the Upsalquitchian valley, and the head of the Northwest on the west, by the Nepisiguit on the north, by Emery's Gulch and a line south to the Northwest on the east, and by the Northwest on the south. Two of its summits I had named earlier for Indian Chiefs prominent in early days in the Province, Halion and Winemowet;* hence I propose to name this the *Chiefs Plateau,* and its summits (excepting Mount Cartier, earlier named by me, Note 30), for other chiefs whose names deserve to be held in recollection. Its highest summit, Chiefs Mountain (2,195 feet), (readily recognized by the huge squarish granite boulder on its bare summit), is separated by a small valley from Halion and Winemowet, but to the southward it extends away as a distinct ridge, sloping very gradually in a series of progressively lower and more distinct summits, around the southernmost of which the Northwest swings to the northward. To the eastward the plateau is partially cut by two streams, branches of the Northwest, and shows several partially isolated bare mountains, of which the most important by far is Mount Cartier, which I shall later describe in connection with the Northwest. The Chiefs Plateau** is the barest and most attractive of all the plateaus, and upon its nearly level summit from Chiefs Mountain to Scudon (this latter summit commanding a fine view up the South Branch above Paradise Pond), we measured our base line from which we triangulated the mountains of the vicinity. The granite ledges of this plateau

* I have since discovered that the Seigniors Ridge described by me in an earlier note (Note 30) is simply another view of Winemowet and others south of it.

** I think this fine plateau could most readily be reached by leaving a canoe at the mouth of the South Branch, following the stream on foot to near the foot of Acquin Mountain and climbing the latter to the plateau.

are glaciated to remarkable smoothness (even smoother than typical roches moutonées), and they are so nearly bare of vegetation that the view is unobstructed in every direction, while one may travel over them as conveniently as across cultivated fields or along good roads. It is indeed one of the purest joys of life to stride in full-pulsing health on glorious summer days over such elevated places as this, where the eye may revel in the spacious distances, the spirit may come into sympathetic touch with all benignant nature, and the mind finds satisfaction in the pride of accomplishment as it solves the problems of the construction of this ancient land.

An important question now arises as to the relation of these great plateaus to the great central peneplain or plateau, which I have described in earlier notes as extending from south of the Negoot Lakes (Notes 55, 56, 64) to Patchel Brook, and beyond that to the northeastward of Thunder Mountain. That the plateau in which the South Branch heads is an extension of this same plateau, there is, I think, no doubt. Since the country falls away to the eastward, as the river courses show, it must be that the axis of this old watershed is now represented by the Bald-Mountain-Historians Range, whence it extends across the Upsalquitchian valley to the Chiefs Plateau, after which it extends across the Nepisiguit (this being the only considerable river which anywhere crosses it), and thence away to the northeastward to reach the sea, I believe, in the vicinity of Belledune. In this region it is cut across by three valleys, partially by that of the South Branch south of Bald, by the Upsalquitchian valley and by the Nepisiguit, and here this important watershed is at its narrowest existent part.

We consider finally the remarkable relations which exist between the valley of the South Branch and of other neighboring valleys. In two earlier notes (Nos. 33, 70), I have expressed the belief that the South Branch is the morphological and ancient head of the Upsalquitch, and this view I find fully sustained by these later studies, though the South Branch proves to be more complicated and interesting than I had thought.

The first striking feature of the valley is the remarkable basin of its upper course, which narrows regularly northward, and, as

seen from Bald Mountain, seems to slope and empty not northward, but southward. So marked is this appearance that, in 1882, as a plan in the Crown Land Office shows, it seems to have deceived the surveyor Freeze into believing that it did actually flow south, and formed the head of the Northwest Miramichi. This all suggests that morphologically this was a southward flowing valley heading near the Notch, and possibly this may be the case. But I was entirely unable to detect any considerable notch to the southward, through which it may have flowed, though possibly such might exist. It seems to me much more probable that this is a basin of erosion of softer rocks, in which connection it is interesting to note that the granite of Bald Mountain appears to be very soft, for it has weathered remarkably around the bare bosses on the summit.*

The second curious relation of this valley to others consists in the existence of a very remarkable valley extending from the First Forks northwest towards the southern extremity of Mount Marie (and for this distance occupied by Minto Stream), whence it swings somewhat more to the west and extends as a very distinct valley, clearly visible from the summit of Mount Elizabeth, all the way to Sagamook and Bernardin, between which it seems to pass. The presence of this remarkable valley is one of the most striking features in the view from Elizabeth Mountain. I have not myself traced this valley except from the mountain, but I recall two other references to it. In 1863 Professor Bailey, in examining Feldspar Mountain, came upon what he describes as a great chasm to the southward of it. Again in a manuscript map kindly sent me by Mr. J. W. Hoyt, showing his timber-surveys in that region, there is marked just south of and parallel with the Nepisiguit east of Little South Branch a "deep dry ravine." Apparently, then, we are here concerned with a single old valley running from the present head of the South Branch through by way of this valley to the mouth of the Little South Branch, including here, perhaps, a little of the Nepisiguit valley, and thence by the valley between Teneriffe and Cooney, by the Nepisiguit lakes,

* Not only on this mountain, but on Chiefs and Historians Plateaus as well, there are remarkable "pot holes," a foot or two in diameter and up to a foot deep, evidently the result of aerial erosion, perhaps aided by fire effects.

the portage valley and Nictor Lake. But, traced so far, it can be traced beyond this in the upper course of the Little Tobique as far as the right-angled bend of that river. This upper South Branch valley represents, I believe, the old head of the Nepisiguit-Lake-portage valley-Nictor Lake valley of which I spoke in earlier notes (Note No. 33, 45), and the entire valley represents the primtive course of a river which arose in the Central Highlands and flowed into Bay Chaleur waters when all the northern Silurian Basin drained that way, if it did not run by an earlier course clear across that Silurian Plateau into the present St. Lawrence river. This valley should be named for the river and lake still occupying a part of its ancient course, *the Nictorian.* We are not without evidence as to the causes which have fragmented this valley as we find it at present, but this subject I expect to treat in a future note.

The third remarkable relation of the South Branch to other valleys is found in the striking valley which lies between the Historians Plateau and the Chiefs Plateau, and which is a perfectly direct continuation of the part of the South Branch valley lying north of Paradise Pond. This valley is as distinct, deep and as old as its northward continuation in which the South Branch now runs. It is, happily for the physiographer (and the canoe portager) mostly open burnt country, so that all its characters may be clearly seen. It is bottomed, and clearly at its northern end dammed, with glacial drift, and less than a mile from the North Branch, and some 100 feet above it, lies a swamp from which one brook runs northward into the South Branch, and another runs southward and forms the present head of the Northwest Miramichi. This latter stream has a gentle slope southward, as will later be described (Note 78). All the evidence seems to show not only that this valley is an old head of the South Branch, but that it emptied into it in immediately pre-glacial times. Its extreme head I was unfortunately not able to trace, but I have little doubt from the appearance of the country from the neighboring hills, that its head is to be found in a southerly continuation of the valley, very probably in the vicinity of Spruce Lake, if not farther southward. The true morphological head of the South Branch, therefore, and hence of the Upsalquitch, was on the east, and not the west, of the Historians range, and it was

later, though still very ancient, changes which turned the upper courses of the Nictorian river into this *Upsalquitchian* valley by the short easterly reach between the First Forks and Paradise Pond.

Finally we notice the possible economic future of this region. It is absolutely impossible for agriculture, and almost valueless for timber, for it will require generations to reforest the region (if it can ever be done), and such little lumber as exists is mostly too expensive to bring out. No minerals are known to occur there, and the nature of the formations does not promise wealth of this kind. It is, however, a great game country, especially for caribou, which find on these barrens their congenial home. This suggests its only apparent economic future, which is as a hunting ground, and the only question is how the Province may best realize the greatest advantage therefrom.

*Place-Nomenclature.*—Following is the origin of names used on the map. Some of them were given previously to this year, as noted earlier in this paper:—*Denys* for Nicolas Denys, early French Governor of all the North Shore; *Cartier* for Jacques Cartier, the explorer; *Winemowet* and *Halion,* for Indian chiefs, early prominent in the province; *Marie,* for Marie (Madame) de la Tour; *DesBarres,* for a prominent early surveyor of our coasts; *Emery's Gulch* is probably for some early hunter or lumberman; *Minto Brook,* of course for the present Governor General of Canada, is from a plan, showing its head, by W. B. Hoyt. Of the new names, *Elizabeth* is for Louise Elizabeth Joibert, born at St. John in 1673, wife of one Governor General of Canada and mother of another; *Kagoot* is the Indian name of the South Branch; *Scudon* is a simplified form of Chkoudun, Indian chief at St. John in 1606; *Ambroise,* for Ambroise St. Aubin, an "august and noble" chief on the St. John in 1777; *Julian,* for a family of Micmacs friendly to the whites; *Francis,* for a chief at Miramichi in 1761; *Acquin,* for Gabe Acquin, a well-known chief and hunter, who died at St. Marys a few years ago; *Neptune,* for Louis Neptune, prominent chief of the Passamaquoddies; *Chiefs,* simply for Indian chiefs and to answer to Acadians and Missionaries Ranges near by; *Micmac* and *Maliseet,* for the two Indian tribes of New Brunswick; *Notch* is descriptive; *Hannay, Raymond, Fisher,* and *Murdoch* are the names of the principal historians who have written on New Brunswick; *Pierce* is for my companion of the voyage; and *Paradise Pond* is in memory of a place at our

home in Northampton, Mass., and of the happy time we had there; *Dashwood,* for the man who first published an account of this region; *Venning,* for Mr. W. H. Venning of Sussex, a veteran sportsman, who as a young man fished on the Northwest and has seen much service for the province; *Bill Gray,* for Mr. Ells' guide in these parts.

The names of various places supplied to me by Mr. Pringle: *Middle, Caribou, Crooked, Canoe, Portage, Spruce, Big,* are obviously descriptive, while *Riordans, Nash, Slacks, Bemis, Colonels* and the camps *Goodwin* and *Waite,* are for sportsmen who have visited them on hunting expeditions in recent years. The latter names represent a new and not especially welcome element now being introduced into New Brunswick place-nomenclature. Each year the guides push farther into the wilderness in search of new hunting grounds and the sportsman, nearly always an American, who happens to be with them when the first moose or caribou is killed, has his name attached to that lake or hill, and these names will undoubtedly persist. Indeed one or two such names have already been applied by one guide at least to some of the places I have re-named. These names, however, are not yet fixed and are used only by one guide, I believe, and, moreover, as I have since found, some of the places are known to lumbermen by entirely different names. I think it quite proper under these circumstances to re-name them, although, as a rule, I prefer to adopt on my maps the names in local use. *Batemans* is a lumberman's name. *Kewadu* is said to be an Indian name, Micmac for Indian devil.

## 78.—On the Physiography of the Basin of the Northwest Miramichi.

Read January 5, 1904.

One of the least known, though in many ways one of the most interesting, of our rivers is the Northwest Miramichi. In early September last, in company with Professor A. H. Pierce, I descended it in a canoe from its extreme source to its mouth, and made the observations which, with some related matters, here follow.

We first note the development of our knowledge of the river. Its lower course appears imperfectly and without name on French maps by Jumeau in 1685, and by Franquelin-deMeulles in 1686; it is first given the name *Minaqua* (the Micmac *Mool-mun-ak-un,* still used) on a French map of 1754, which name was followed on

many other maps, though the river to which it becomes applied on most of them is the Little Southwest, and not the Northwest. On modern maps its lower course below Portage Brook is first shown, from a sketch, on Bonnor, 1820, but it is first laid down from survey on Lockwood's map of 1826. Above Portage River to near the South Branch it was first surveyed (and the country laid off in five-mile timber blocks) by Peters in 1836, and his plan is followed on Saunders' map of 1842, with some extension at the headwaters on Wilkinson of 1859, and with further additions at the headwaters on Loggie of 1884. Loggie's map was followed with but very slight changes by the Geological Survey map of 1888, and this has remained the best down to the present. Parts of its branches, and many of the old timber lines have been resurveyed in recent years by Hanson. No map whatsoever up to the present has correctly represented the position of its source and the curious course of its upper valley, and these appear with approximate correctness for the first time on the map accompanying an earlier note, No. 77.

The lower course of the river was early settled by the descendants of the Loyalist and Scotch settlers of the Miramichi, to whom some later immigrants have been added, and settlement has gradually extended up to the mouth of Portage River, and somewhat above. Above that the river is, except for some five or six fishing and hunting camps, and a few lumber camps, an entire wilderness, abounding in all kinds of big game, while the river itself is one of the finest of salmon streams. Except at its head it flows through forested country, which has yielded great quantities of lumber, and lumbering is still actively carried on every year.

Of literature, scientific or other, relating to the river, there is very little. Hardy's "Forest Life in Acadie," (1869, page 240), refers to the excellent salmon fishing on it, and refers to a portage to the Nepisiguit, doubtless that by Portage River. Dashwood's Chiploquorgan (1871, 60). seems to show that in 1863 he portaged from Kewadu Lake to this river, and descended it in part to Newcastle. The geology of the river was studied by Ells, who in 1880 (Note 77) crossed its headwaters, and the same year studied the lower river below the Winigut Lake Branch. His results are

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recorded in his Report for 1881, and upon the Geological Survey maps. Later, in 1886, the surface geology of the lower river from Tomogonops River downwards was studied by Chalmers, whose comments upon it are contained in his Report for 1888, and upon his surface geology map. Many sportsmen have visited the river in recent years, for salmon, or for moose and caribou, but, aside from scattered notes in sporting journals, none of them appear to have published any accounts of their adventures.

In its physiographic characteristics the river falls into five sections, which I shall now describe and discuss separately.

First Section. *From the source to Cartier (Little Bald) Mountain.*—The Northwest rises in a wooded swamp lying in the deep valley which is an extension of that in which runs the lower course of the South Branch Nepisiguit (see map accompanying note No. 77). This swamp is but little over a mile from the South Branch, into which it sends also a small brook. The Norwest flows east of South through a series of short open boggy deadwaters and alder-grown abandoned beaver ponds, separated by short stretches, mostly through woods, of little fall through boulders, until, somewhat over two miles from the source, it unites with another stream of nearly equal size, coming in part from behind Murdoch Mountain, and apparently in part from farther south. This upper two miles is to some extent navigable for canoes in fair water, though with more portaging than floating; the portaging, however, is very easy because of the open barren character of the country. Below the Upper Forks the stream swings somewhat west of South for nearly a mile and a half farther, and is readily navigable for canoes. At first there are some obstructions from shoals, and, after entering the woods, from deadfalls, but gradually it becomes an open, easy and very charming canoe stream, with little fall, gravel and boulder bottom, clear water, and pleasant wooded banks. Finally it makes a great bend to the eastward, receiving here a considerable stream from the south, and flows northeast, entering the remarkable region of steep, conical, perfectly bare, rocky hills amidst which it winds in a very deep sinuous valley down to Mount Cartier, receiving two important branches from the north on the way. This part of the river, as well as the part above to its source, is everywhere

drift-bottomed, but the fall steadily increases, though the stream is without obstructions, so that with its swift clear current, gravel bottom, winding course and superb hill views, this part of the Northwest is one of the most charming pieces of canoe water that I have seen anywhere in New Brunswick.

We consider now the probable physiographic origin of this interesting part of the river. I have already pointed out (Notes 70, 77) that the source and upper four miles of the river lie in a valley which is a continuation of, and morphologically the head of, the valley of the South Branch Nepisiguit, which in turn formerly emptied by Portage Brook through the Upsalquitch, the entire valley being properly called the Upsalquitchian valley. Moreover, the presence of the very obvious glacial dam between the source of the river and the South Branch Nepisiguit shows that this valley doubtless emptied into the South Branch in immediately pre-glacial times. The remainder of the river down to Cartier is very much of a puzzle, and its history is intimately associated with the causes which have formed the remarkable, nearly isolated, conical hills here prevailing. That these have been carved by numerous streams (perhaps anciently flowing southeast) from the great central peneplain seems most probable, but the particular method awaits more detailed study than I could give the problem. It is very probable that Beaver Brook, the stream flowing from the Chiefs Plateau east of the Chiefs Ridge, is the true morphological head of the Northwest, and that the part thence to the Upsalquitchian valley is an old branch of it. All this part of the valley throughout is typically pre-glacial, the river flowing entirely over drift in a valley which, while deep and narrow, is obviously by no means new, and may be very ancient. An important question now arises as to the place and nature of the pre-glacial connection between this and the Upsalquitchian valley. We would expect that a post-glacial gorge or valley would be found just where the southward flowing upper course turns to the eastward, but in fact no such post-glacial portion appears, and I can only surmise that the quantity of drift thrown down in both these valleys was sufficient to completely bury the pre-glacial rock-boundary between them.

A notable feature of this part of the river consists in the

remarkable hills already mentioned, all of those near the river being burnt completely bare. They have been hitherto unnamed, and I have given some of them names for reasons stated in Note 77. Among them one stands out with especial prominence, the one I named in 1898 *Mount Cartier,* and known to the guides and others as *Little Bald.* It has a bald, squarish top, almost like a "table-mountain," which, with its superiority in height over all others in its vicinity, makes it conspicuous from every direction, and causes it to seem to stand up higher than it really does.* The view from its summit is certainly one of the best in the Province, for it embraces all of the principal mountains of north central New Brunswick, and a wonderful expanse of typical northern wilderness, with boundless forests, interspersed here and there with anciently burnt barrens, which, with their occasional oases of vegetation, curiously simulate cultivated, and even park-like, landscapes.

SECTION 2. *From Cartier (Little Bald) Mountain to near Glory Hole Brook.*—Below Cartier the river swings to the south and later to the southeast, and down to the entrance of the South or Spruce Lake Branch it continues an ideal canoe stream, winding swiftly, but mostly smoothly, over gravel and amid alders and woods in a deep valley amid fine hills. In this part of the river are some beautiful pools filled with small salmon, which spawn here. At the entrance of the Spruce Lake Branch (much smaller than the main river), which enters in a large open basin, the character of the river begins to change, and it becomes broader and shoaler, and flows more swiftly over small cobbles and with some boulders. The valley also is now not so deep, and the hills, all heavily forested, begin to assume the flat-topped and continuous character distinctive of plateau or peneplain country. These characters become more and more marked in descending, the valleys become broader and riper, the hills lower and more plateau-like, and the river bed broader, shoaler, and with more drop. Finally after passing the bend above Glory Hole Brook the first ledges extending clear across the river are met with, and a new section of the river is reached.

The physiographic history of this part of the river seems

* It is not much, if any, over 2,200 feet. Compare Note 76.

sufficiently plain. It is the original valley of an ancient river flowing out of the central watershed, one of that radiating series established on the first elevation of the central watershed. It is possible that its present course past Cartier may not be the original one, but that it may have run across more directly to the present head of the river.

SECTION 3. *From above Glory Hole Brook to below Stony Brook.*—We now approach the most remarkable part of this most interesting river. At the bend above Glory Hole Brook, ledges extending across the stream are first met with, and below they become more frequent. The river has more fall, and becomes gradually rougher, making canoe navigation difficult, until finally, two miles below Glory Hole Brook, is a vertical ledge fall of some eight feet. Below this the river becomes still rougher, with incessant rocky rapids and low falls down to Mountain Brook, and a mile or more beyond, when it plunges over falls through a fine irregular post-glacial gorge (with a portage of a quarter-mile on the right bank). This is one of the wildest and roughest river gorges in New Brunswick, and its impressiveness is increased by the fact that one can view its entire length, with all its falls and irregular cliffs, from a single view-point, at a bend midway of its length. Below this the river continues rough for half a mile, when it plunges into another irregular gorge with fine falls and pools, in some ways wilder, though smaller, than the one above. There is here a portage of 160 yards on the right bank past a salmon club-house. This house, like the others above and below it, is reached by portage roads, cutting directly across country from the settlements to the southeast. A short distance below this gorge comes another, with typical vertical walls, but straighter and with smaller falls, so that a canoe can be worked through it with one short portage, though it would be easier to portage around it. Below this the river continues rough for a mile or more, when suddenly there loom up the great cliffs at the head of the finest gorge on the river, and in many ways the finest in the Province. The river here cuts across an elevated ridge or hill range, and above the vertical cliffs can be seen the lofty wooded hills extending off on both sides of the river. The walls of this gorge are almost perfectly vertical, and rise higher than any

other cliffs I have seen in New Brunswick, nearly, I should say, 200 feet, and much higher than those of the Grand Falls of the St. John. The view from the top of these cliffs into the narrow gorge is one of the wildest I have seen in New Brunswick. The falls are insignificant, however, and possibly a canoe could be worked through it at low water; there is a portage of 500 yards over the hill on the left bank. Below the gorge the river continues somewhat rough, and for half a mile further the fine great cliffs continue on one side of the river or the other, though the river here does not fill the valley, and has not the typical post-glacial character. When these grand cliffs end the valley begins to open out, and continues to broaden, and the river becomes less rough, down to Stony Brook, where a new section of the river begins.

Considering now the physiographic origin of this section of the river, it is obvious that it is all very recent and mostly post-glacial. It seems to me plain, therefore, that the entire river from the bend above Glory Brook to Stony Creek is not in its ancient valley, and that either (1) there is a pre-glacial channel from that bend to Stony Creek along the south of the river and parallel with it, or else (2) the upper course of the Northwest flowed in pre-glacial times by some valley now drift-filled from the Glory Hole Brook Bend into the Sevogle to the south, in which case the present valley probably is that of Mountain Brook, into which the river was turned by the damming of its southern outlet. It is quite possible also that we are concerned not only with a post-glacial, but with an "interglacial" course of the river, for the remarkable cliffs below the gorge are certainly not in a typical post-glacial valley, and yet they certainly do not belong to an ancient river valley, for, except for the greater width of the valley here, they seem as new as the post-glacial cliffs of the gorge itself.

SECTION 4. *From Stony Brook to Portage River.*— Below Stony Brook the river flows over gravel and boulders instead of ledges; it is broader, shoaler and with less fall, making canoe navigation easy when the water is of fair height. The country becomes much lower, and finally quite flat, and seemingly little above the river level. In the upper part of this section there are occasional cliffs on one side or the other of the stream, and about

a mile below Stony Brook the river passes through an interesting gorge, which appears not to be post-glacial, but probably belongs to the type described elsewhere as "inter-glacial," for, while it has vertical cliffs on both sides, the stream flows through it over drift, and its bed does not fill the gorge. Finally as the river nears the junction with Little River it is flowing over a broad shoal bed with low banks, rising to occasional cliffs on one side or the other, through a country showing no hills above the vegetation of the banks. It now bears a remarkable resemblance to the part of the Nepisiguit between the Narrows and the Grand Falls, and probably has had a similar origin and history. This character is preserved to the Tomogonops, a dark-colored stream from the northwest, or approaching which fertile intervales with some signs of cultivation begin to appear.* Here the river swings into what is obviously the Tomogonops valley, which it follows to Portage River, through a charming level country between intervales and terraces.

This part of the river is certainly puzzling physiographically. Its swing to the northeast when the general direction of the valleys of this region would lead us to expect a southeast course, suggests that the part below Little River at least should be post-glacial, but it obviously is not. Its course from Little River to Tomogonops suggests that it may have had a pre-glacial outlet into the Nepisiguit by way of Portage River, and this may have been the case, unlikely as it seems. An objection to this is that the same explanation would seem to have to be given for the direction of the South Branch Sevogle just above the Square Forks, and this is hardly at all probable. On the other hand this curious northeasterly turn is characteristic not only of this river and the South Branch Sevogle, already mentioned, but of other branches of the Miramichi, Dungarvon, Renous, Little Southwest, etc. (see map with Note 50), and of the Nepisiguit above Grand Falls, so that this change of direction of them all would seem to be due to a common cause. The Geological maps show that in general this common change of direction occurs just west of the line of Lower Carboniferous rocks, and hence it may in some way

* The arrangement of the rivers on the map suggests that Little River may at one time have followed the brook emptying near Tomogonops.

be connected with their presence. It may be that it represents the general line at which these many rivers, flowing radially out of the great central watershed, met the eastern Carboniferous plain, which had a general northeasterly slope. Another possible explanation of the part of the river under consideration is that while not post-glacial, it may be "inter-glacial," and hence not older than the glacial period. In this case a pre-glacial channel ought to exist running southeast to near Chaplins island. As confirmatory of the "inter-glacial" character of much of this valley, I may mention one striking fact. At the "inter-glacial" gorge a mile below Stony Brook, the river cuts through a lofty ridge, probably nearly 200 feet high. Now just west of this ridge, and parallel with it, is a deep, broad valley running nearly north and south, seeming to show that the original drainage was south or southeast, not east, as at present. And I fancied elsewhere that I detected evidence of a similar north and south drainage between ridges having that direction. But my visit was too hasty to allow me to obtain other evidence upon this interesting question.

In an earlier note (No. 33) on the physiographic history of the Nepisiguit River, I made the suggestion that some of the features of its course below Indian Falls are best explained by supposing that it is a composite river, parts of which formerly (of course in times long pre-glacial) flowed into the Miramichi system. I have no new evidence at present to offer, but all facts available seem to me in harmony with this view. In this case it is likely that Tomogonops headed in the main Nepisiguit near Indian Falls, and Forty-four Mile Brook was the head of that part of Nepisiguit below it, while Little River headed in Upper Forty-two Mile Brook, and the valleys in which its source-lakes lie.

SECTION 5. *From Portage River to Red Bank.*—At Portage River the Northwest turns to the south and keeps that general direction to Red Bank. For the most part the river flows with a strong current over gravel, and occasionally among boulders, but there are frequent long stillwaters and pools, and in one place at least its course is over ledges and through a small post-glacial gorge. The banks are mostly intervales and terraces, all

well settled, but occasionally there are low cliffs on one or the other side of the river. Altogether it is a charming river, bringing ease to the canoeman fresh from the labors of rapids and portages on the river above.

The origin of this part of the river has been traced in an earlier note (No. 50). Its morphological head was no doubt Portage River, and the valley in which they lie is part of an anticlinal trough containing also the Lower Nepisiguit, and the curious right-angled bends in the Main Southwest Miramichi. No doubt this great trough has been formed by an uplift of the country to the eastward. Many details, however, remain to be worked out in this region, and it is one of the most attractive physiographically in the Province. The post-glacial bed and gorge below Trout Brook probably indicate nothing more than a slight change in the course of the river, and some search would no doubt reveal the pre-glacial channel of the river either to the east or the west, though if it should prove that the Northwest emptied pre-glacially into the Nepisiguit, this gorge would probably mark the position of the pre-glacial divide.

SECTION 6. *From Red Bank to the Main Southwest.*—This part of the river belongs morphologically to the Little Southwest, though it bears the name of the Northwest, this custom having originated, without doubt, in the desirability of making a clear distinction between it and the Main Southwest. Its physiographic history as the lower part of the Little Southwest is sufficiently plain. It is tidal, and a typical drowned valley.

## 79.—ON ADDITIONAL NATURAL CURIOSITIES SAID TO OCCUR IN NEW BRUNSWICK.

Read February 2, 1904.

In an earlier note (No. 57), I mentioned a number of curious natural objects or places reported from various parts of the Province, all of which seem deserving of investigation. It is worth while to ascertain the truth or falsity of such reports, and besides one may thus be led to some discovery of genuine scientific interest. Some others which have lately come to my notice are now to be described.

### *The Rumbling Mountain and Burning Mountain of Tobique.*

In the former note (No. 57), I mentioned the statement made by residents on the Tobique that there is a spot on Blue Mountain which is much warmer than the surroundings; and also that there exists on the Wapsky a mountain from which strange rumblings are heard. During the last summer I was told by one of the best guides on Tobique, in all sincerity, that the mountain with the warm spot and the rumbling mountain are one and the same, that it is on the Odell, eight miles up on the southwest side of the portage road, and that it is commonly known both as the "Rumbling Mountain" and the "Burning Mountain."

The noise is heard only occasionally, and is said to resemble thunder, and persons new to the region are said to be much astonished when they heard what they take to be thunder from a clear sky. The ground is described as so warm that snow never lies long upon it, and leaves, etc., soon dry up. There is probably some exaggeration in these statements, but I believe they have some basis, which should be scientifically tested.

### *Abnormal Magnetic Variations.*

Magnetic variation in New Brunswick is referred to in Note 58, but no cases of abnormal variation are there mentioned. Mr. W. B. Hoyt, deputy surveyor, of Andover, writes me that, as a result of studies he has made upon old surveys by H. M. G. Garden, he has found a certain variation in a part of the survey of Green River, which, "I am satisfied, indicates a small area of magnetic depression, and may be connected with an erratic movement on Green Mountain, which is founded, I think, probably on the existence of iron ore in that neighborhood."

Another and much more striking case is recorded upon Playford's "Plan of the Survey of the North Line of the New Brunswick and Nova Scotia Land Company Purchase," 1833, (in the Crown Land Office), which, at a spot not far southwest of Miramichi Lake, has this legend: "Find the magnet attracted from four to ten degrees."

*The Poison Spring of Lake Stream.*

A valued correspondent, Mr. P. H. Welch, of Fulton Brook, Queens County, writes me that at the head of the Lake Branch of Salmon River are two lakes (which, by the way, are not marked on any existent map of the Province), at the head of the upper of which is a spring, " the waters of which appear to be poisonous to fish. Perhaps a half ton or more will be found dead where they come from under the ice to drink the spring water. This occurs mostly in winter."

The publication of this note in the *Daily Telegraph* for February 13, 1904, brought me a communication from Mr. I. T. Hetherington, of Johnston, Queens County, who says: " The fact that thousands, in some seasons tons, of suckers, chubs, horned pouts and pickerel die annually in this lake, seems to be a fact patent to all lumbermen and hunters who frequent these lakes in the last part of February and March. The cause thereof has been much discussed by them. Some contend, as does Mr. Welch, that the spring poisoned them. But I am informed by our most experienced guides that the water in both summer and winter is a fine drinking water, cool in summer, and so warm in winter that it never freezes over. As the dead fish always are in greatest quantities when the snow is heaviest, it seems to me not improbable that when it becomes darkest under the ice on account of heavy snows, the fish press to the light, and as the open space is then so small as not to allow room for movement to the great numbers that congregate there in such quantities, those coming in under the others naturally lift the top tier above water and they freeze. This is as Fish-warden Curry explained it to me, and in my opinion it is the correct view. For the lumbermen use the fish as food, and if they had been poisoned they would certainly leave some bad effects on those who eat them." Dr. Hetherington also adds: " It is also said there are horned pout in those lakes weighing five to eight pounds, also a species of sucker or carp, also weighing seven to eight pounds."

I do not guarantee any of these statements, but I have no doubt they have a substantial basis in fact. Here is a grand opportunity for some of our young naturalists, who should survey those still unsurveyed lakes and their surroundings, investigate

the fish life of those waters, study the vegetation in contact with the spring water, and bring out an ample supply of the latter for chemical analysis.

*The Coal Creek Salt Springs.*

Mr. Welch has also given the following description of the Coal Creek Salt Springs, which appear to be entirely undescribed in our scientific literature: " They rise out of a gravel bed or bar about a foot or more above low water, and are covered in high spring freshets. They are about ten feet across either way, and about a foot deep, and they taste quite salty. They are on the right bank ascending the stream, and about thirteen miles from its mouth." He also adds that they are the greatest resort for moose in New Brunswick. The study of these springs may yield some botanical results of interest, although the high freshets may prevent the occurrence there of a typical halophytic flora, such as the Sussex springs possess. (Note No. 7).

*The Boulder Hill on Coy Brook.*

Mr. Welch has also given me a description of another natural curiosity, in substance as follows: There is a curious rock formation on Coy Brook, a branch of Lake Stream. It occurs on the right bank as one ascends, five miles from Lake Stream, and half a mile above the forks of the brook. On the top of a high ridge, on the highest part, there is a heap of loose boulders (many would weigh 400 tons), piled up like a pyramid without any clay between them. Some are split, the parts lying ten feet apart, showing their fracture, with other rocks lying between them. One can go in through them, so loosely do they lie. The pile is perhaps thirty feet high, and the base covers nearly one-fourth of an acre. A lot of loose stones have rolled down and away from the pile for perhaps fifty feet. From the pile there runs a ravine which looks as if it has been a brook, but it is now dry.

*Caves, Underground Waters, Etc.*

A number of additional cases of those interesting phenomena have been cited by Professor Bailey in his paper read before this Society recently, and published in the present Bulletin.

Can any of my hearers give any further information about these places?

## 80. —The Walrus in New Brunswick.

Read April 5, 1904.

It is generally known that the Walrus or Sea-cow (*Trichechus rosmarus*) formerly occurred along the north coast of New Brunswick, but the evidence for its occurrence is not readily accessible. Cooney, (Northern New Brunswick and Gaspé, 1832, page 30), speaks of its former (traditional) occurrence on Portage Island, Miramichi; and Perley, (Reports on the Sea and River Fisheries of New Brunswick, 1852, page 33), speaks of the former prosperous fishery for these animals at Point Miscou, and tells us that on his visit to Grande Plaine, near Point Miscou, in 1850,—

The bones of the Walrus which had formerly been slain there, were found imbedded in the sand in large quantities, and in good preservation, some of the skeletons being quite complete.

So far as I can find, these two are the only positive original references to its presence in New Brunswick waters in the accessible New Brunswick literature.* Very much more exact and very satisfactory information on the subject, however, occurs in the very rare and little known book, "Narrative of an Extraordinary Escape out of the Hands of the Indians in the Gulph of St. Lawrence," by Gamaliel Smethurst, published in London in 1774. In the course of the description of his journey, in October to December, 1761, from Nepisiguit along the coast to Baie Verte, the author has the following references to the Walrus:

November 20. The Frenchman where I lodged, and most of the village [on the site of the present Neguac Village] set off this morning for Point Miscou, to hunt sea-cows for their oil, which they make use of in winter instead of butter. (Page 18).

December 9. Came to a large river, called Chedaick [Shediac] . . . . A sea-cow lifted its head out of the water, and came swimming after the canoe—the Frenchmen soon shot it—it had 2 large teeth out of water in the upper jaw pointing downwards—these serve for defence, to climb rocks with, &c.—a full grown sea-cow will make two barrels of oil in autumn, when they are fattest—they are easily killed with a ball—very unwieldy—

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*Adams' Field and Forest Rambles, 39, and Gilpin, Trans. Nova Scotia Institute of Nat. Science, II, 126, also refer to the subject, but with no new facts.

An interesting account of the Sea-cow fishery in Prince Edward Island is given by A. B. Warburton in "Acadiensis," III, 116-119.

much like Anson's sea-lions*—I believe of the same species—this was larger than an ox—The French use the oil of these creatures to their meat—it is to me as rank as seal oil—The most noted places for their present resort, are the islands of Magdelines, and Point Miscou; but the sea-cows, wild fowl, Indians, and beaver, will leave us as we settle in the country, and go to places less frequented. (Page 24).

This is the only recorded observation of a living Walrus in New Brunswick waters known to me, and very satisfactory it is.

Two years later, in 1763, Smethurst, as he tells us in his book, was shipwrecked near Pictou, Nova Scotia, and made his way, in December, along the coast to Baie Verte. Near Tatamagouche Harbour,—

We passed by a great many rocky points, on one of which was a young sea-cow asleep—I went softly up to it before it awoke—exceedingly like Anson's sea-lions; only this had no snout, but a long brizly beard—we had no gun with us—upon Mr. Richardson's advancing, it started and slid down the rock into the sea—it was not quite the size of an ox. (Page 32).

Again, when near Tidnish, and nearly famished,—

saw some sea-cows upon the rocks—Mr. Richardson intercepted two calves, and easily killed them—they were very fat like seals—Stopt and made a fire—dressed some of the sea-veal, which we eat greedily—it would at another time have tasted very strong; but now we thought it very delicate.

It would be interesting to know when this animal became extinct upon our shores. It is very probable that the relentless onslaughts upon it as the country gathered population after 1767 soon drove it from these shores. It does not now occur nearer than Labrador.

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* He refers here to the sea-elephant, formerly called scientifically *Morunga ansonii*, a huge seal of the Southern hemisphere.

## NOTE BY THE EDITOR.

### RELATING TO THE LIFE OF DR. A. GESNER, THE GEOLOGIST.

In Bulletin XIV of this Society will be found a life of Dr. Abraham Gesner, who made the first geological survey of this province. Many interesting incidents of Dr. Gesner's career are given in this biography, and it led to the writing of a letter from a grandson of the geologist to the secretary of this Society, giving additional details of Dr. Gesner's lineage, and a correction on one point:

"Arthur T. Gesner, Assistant Rector of the Shattuck Military School, Farebault, Minn., the writer of this letter, says that the founder of the family in America was John Gesner, of Old Tappan on the Hudson. His son, John Gesner (Jr.), born 1724 * * * and his wife were buried in the old graveyard at Old Tappan. Of their eight children, six sons and two daughters, *Henry* was the ancestor of the Nova Scotian branch; he married Sarah Pineo, May 4, 1786. Of their twelve children, ABRAHAM (the sixth) was born May 2, 1797, at Halifax, lies buried in the Camp Hill cemetery in that city." This was the geologist.

Mr. Gesner also claims that the story that Major Andre was executed on the property of the Gesner family is a "tradition," and not substantiated.

ARTICLE V.

# RECENT EARTHQUAKES IN NEW BRUNSWICK.

By Samuel W. Kain.

In an earlier Bulletin of this Society (No. XVI, pp. 16-22, 1898), I gave a short account of earthquake shocks felt in this province of which a record was obtainable.

Since the publication of that article some shocks have been felt, and it may be of interest to briefly record them. The time given in all cases is Atlantic Standard (60th meridian).

**1898. August 14; 3 a. m.**

Shock on St. John river between Torryburn and Oak Point; felt most severely in vicinity of Oak Point. Not felt in city of St. John.

**1903. December 17; 10 p. m.**

A shock felt in Upper Keswick and part of the Tobique valley, and also at Bathurst. A Fredericton despatch to one of the St. John papers thus refers to it: "Residents of Upper Keswick who were in the city to-day report that a distinct shock of earthquake was felt in their locality at 10 o'clock last night. It rattled dishes and window panes, but did no damage."

Mr. Craig C. Williams, of Maple Veiw, Tobique, in a letter to Professor W. F. Ganong, written some days after, thus refers to this shock: "One night last week there was a shock of an earthquake, or a rumbling, shaking noise heard in all the camps on the right hand branch of Tobique. In some camps the men got up and went out to see what was the matter. It was heard in six camps, one quite close to Bald Peak. It was not heard on any other part of Tobique."

In a letter to the writer, dated at Bathurst Village, April 13th, 1904, Dr. G. M. Duncan, one of our corresponding members, says: "Before New Year's a light quake felt here." This probably refers to the shock of December 17th.

**1904. February 27; 11 p. m.**

The same observer says: "There was a very slight tremor about 11 o'clock Saturday night, February 27th.

**1904 February 28; 8.37 a. m.**

This earthquake was of considerable violence, and was felt in parts of northern New Brunswick, more particularly in the region about Bathurst. Dr. G. M. Duncan wrote me thus about it: "This shock was preceded by, or announced by, a noise like a gunshot, loud and sharp, giving the impression of rending a large rock. It was followed at once by the sound that seems to introduce all quakes—a sound like the blowing of a high wind. Then came the noise of a grinding and the sound of grinding with the tremor of the earth and buildings. Rev. Mr. Read thought the sound was a gunshot on the roof of the manse."

**1904. March 21; 2.04 a.m.**

This earthquake was markedly felt in New Brunswick, Nova Scotia and New England, and naturally excited much interest throughout the region where it was felt. The daily newspapers gave very full accounts of the shock as felt in New Brunswick, and I have also secured some additional facts by correspondence with observers outside of St. John. The shock was undoubtedly one of the most violent felt here, but was not quite so severe as that of October 22, 1869. At the time of writing I have not seen any careful accounts of the shock observed outside of this province. From what evidence I have been able to get, it would appear that the shock was more violent in and about St. Stephen than elsewhere. I gather also that the motion was from southwest to northeast. There is very considerable difference of opinion as to the interval between the two shocks Some observers say two minutes, some three, some four. Mr. H. E. Gould, of Sussex, who was awake reading at the time, tells me that the first shock took place at 2.04 a. m., lasting about fifteen seconds, and that after an interval of four seconds a second shock was felt lasting about ten seconds. Mr. C. F. Tilley made a like estimate of the time. I was not awake at the time, and so knew nothing of the matter till this morning. I will now give a few notes on the effect experienced at different places in the province.

St. John.—Many people were aroused by the shaking of houses and beds. In some parts of the city dishes and doors rattled. The shock was felt most severely in buildings erected on clay and gravel areas. The most marked result of the shock was a crack sixteen feet long in wall in Jones' brewery. This building is built on a deposit of gravel, sand and clay. Plaster was cracked in a house on the corner of Broad and Carmarthen streets. Mr. Charles F. Tilley, of the customs, informs me that at his house on the west side of the harbor, at the corner of Ludlow and Water streets, the shock was very pronounced, throwing a large silver dish from a marble top sideboard

to the floor. A number of glasses and cruet stands on the same sideboard were overturned. Mr. Tilley's house is built on a deposit of clay and gravel.

Mr. D. L. Hutchinson went to the Observatory before daylight and found the standard clock going and in good order. He took a set of star observations for time correction and found that the clock was correct.

BATHURST.—Dr. G. M. Duncan says: "It lasted about twenty seconds. Judging by the position of my bed, and the wave-like motion of my bed, I concluded that the shock was from southwest to northeast. This was followed in about five minutes by a slight tremor quite distinct. It was less distinct in Youghal, fifty miles off."

ST. STEPHEN.—It would seem as if the shock was felt at St. Stephen more severely than in any other part of the province. Several chimney tops were thrown to the ground, some bricks were loosened from the walls of the Methodist church, and a number of panes of glass were broken in the Chipman Memorial Hospital. A locomotive in the C. P. R. roundhouse started forward and had to be stopped by the driver in charge. One correspondent, in a letter to Prof. W. F. Ganong, says: "The pictures were hanging cornerwise the next morning." A number of people reported a third shock at six in the morning.

ST. ANDREWS.—The shock was well marked in this town and vicinity. In some cases dishes were thrown to the floor and ornaments rolled over. On Minister's Island a crack was made in the corner of the stone wall of a house on the VanHorn farm.

GRAND MANAN.—One of our corresponding members, Mr. D. I. W. McLaughlin, of Grand Harbor, sent me very full notes on the effect of the shock there. It was not so violent as at St. Stephen.

# NOTES ON CAMBRIAN FAUNAS, NO. 9.

In the Transactions of the Royal Society of Canada, the writer has from time to time offered additions to the Cambrian faunas under the title of "Studies, or Notes on Cambrian Faunas." The following may be considered a continuation of those notes:

## PROTOLENUS.

This genus is represented at a later time in Europe in Anomocare of Angelin, found in the Upper Paradoxides beds of Sweden. This genus like Protolenus was characterized by an elongated eyelobe, and usually by a cylinderical glabella; the species also in most cases had a broad anterior limb to the moveable cheek. This latter feature is not clear for *A. læve* from Angelin's figure,* but it is more evident from Gronwall's represtation.** This character seems to have been overlooked by authors who have referred to Anomoacre species with short eyelobes, perhaps depending on Angelin's figure of the type species.

But while Protolenus has a rather broad anterior limb to the fixed cheek, it has not the exaggerated expansion found in most of the Swedish species of Anomocare; neither has it the small lobes found on the fixed cheeks near the glabella in most spiecies of this genus; the variety *bituberculatus* of *P. paradoxoides,* however, has a small swelling near the base of the glabella, corresponding nearly to that seen in *A. aculeatum* (= *difforme*). It is probable that the pygidium was more feebly developed in Protolenus than in Anomocare, and at least one species of the former (*P.* (*B.*) *articephalus*) had one more joint in the thorax than Angelin represents for any species of Anomocare. Nevertheless there may have been a relationship of descent between the two genera, Angelin's being the later.

* Pal Scandinav; Tab. xviii. fig. 1.
** Bornholms Paradoxideslag, Tab. 4 fig. 8.

ARTICLE VI.

# NOTE ON THE GENUS HYLOPUS OF DAWSON.

By G. F. Matthew, LL.D., F.R.S.C.

Read November 3, 1903.

Sir Wm. J. Dawson describes the several footprints of quadrupeds of the Carboniferous age obtained from the Joggins, Parrsboro, Horton and Sydney, Nova Scotia, under the two genera, Sauropus and Hylopus.

The latter genus being Dawson's own, it behooves us to examine the types and learn what its characters are. He defined the genus Hylopus as follows: "Smaller footprints [than Sauropus, Lea] digitigrade, and made by animals having a long stride, and hind and fore feet nearly equal. Five toes. Probably footprints of Microsauria, and possibly of Dendrerpeton."*

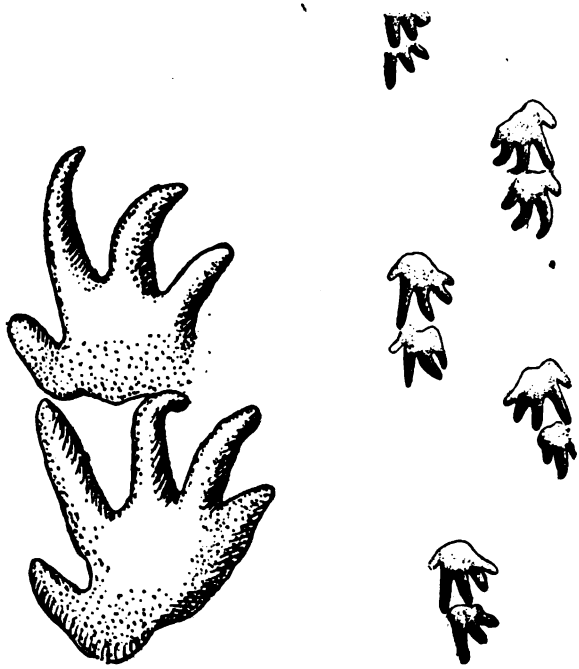
This genus was based upon three species described in Sir William's "Air-breathers of the Coal Period,"** and figured in the same essay, but not then named; in the later essay they have names given them, and an additional species is described. There is so much variation in the form of these footprints that they cannot all be contained in the genus Hylopus, and it becomes necessary to select a type or types to represent the genus. There are two forms which appear to come nearer the ideal of Dawson's genus than the others, these are *H. Logani* and *H. Hardingi.*

It would appear from the figures given in the "Airbreathers" that both of these species were described from casts, one of which, *H. Logani,* is in the Redpath Museum, Montreal, the other, *H. Hardingi,* in that of King's College, Windsor, N. S. Both species are of Lower Carboniferous age, and come from measures underlying the Carboniferous limestone. The author has been favored with an opportunity to examine both of these casts, and

* Trans. Roy. Soc. Canada, Vol. XXII, Sec. iv, p. 77, 1894.
** Air breathers of the Coal period . . . . . of Nova Scotia, Montreal, 1863.

so has seen the objects on which Sir William has based the genus Hylopus.

The series of footmarks which are the type of *H. Logani,* are supposed by Sir William to have been made in soft mud by an animal partly water-borne, and they are decidedly " digitigrade," in some cases only the long middle toes scrape the surface of the



A B

FIG. 5.—Hylopus Hardingi, Dawson. A—Print of the hind and fore foot, B—A series of footprints, one-fourth of the natural size.

mud, and were not impressed upon it, and in the most distinct only the toe-marks are preserved, hence the track is truly digitigrade. But this is not the case with any of the other species; all of them have the print of the sole of the foot preserved.

The imperfection and irregularity of the track in *H. Logani,* which by Sir Wm. Dawson himself is said probably to be that of

an animal partly water-borne, prevents one from using this as the type of the genus; we therefore fall back on the second species as the one which can be taken as a generic type. This species is *H. Hardingi.*

The first reference we have to this fossil is in Lyell's Elements of Geology (New York, 1866, p. 510), where the author says: "Footprints of two reptiles of different sizes had previously been observed by Dr. Harding and Dr. Gesner on ripple-marked slabs of the lower coal-measures in Nova Scotia, evidently made by quadrupeds walking on the ancient beach, or out of the water, just as the recent Menopoma is sometimes observed to do."

The footprints are again referred to in Dawson's Acadian Geology (London, 1868, p. 356), with figures). Here Sir William says (p. 356) that Dr. Harding, of Windsor, when examining a cargo of sandstone from Parrsboro, N. S., found on one of the slabs a very distinct series of footprints, each with four toes, and a trace of a fifth. Dr. Harding's specimen is now in the museum of King's College, Windsor. Its impressions are more distinct, but not very different otherwise from those found at Horton Bluff [*H. Logani.*]

According to "Airbreathers," (p. 9, Explanation of Plates, Fig. 2), the figure of *Hylopus Hardingi* is from a rubbing taken by Professor How, of Windsor College, and was evidently taken from the cast of the fossil. Prof. How apparently failed to perceive and to indicate the impression of the sole, or "heel," and so the drawing appears to be taken from a digitate print, whereas the imprint shows plainly that the animal rested on the sole of the foot as well as on the toes, in walking. There is therefore no species of Hylopus in which the impression of the sole is entirely wanting, except that of *H. Logani,* whose peculiar impressions we have noted above.

There is a marked advantage in the regularity as well as in the distinctness of the tracks of *H. Hardingi* to the observer who wishes to learn what the characteristics of the genus Hylopus are, for they show distinctly the sole of the foot, and so approach a type of footmark common in the Carboniferous system. Hylopus, therefore, was made by an animal which did not walk

on the toes alone, but also pressed the sole of the foot to the ground.

Hylopus (as represented in the species *H. Hardingi*), clearly had five toes to the hind foot, but the fifth toe of the forefoot is mistakenly shown. In his "Airbreathers," Sir William Dawson says (p. 7): "One pair of feet [the hind feet?] appears to have had four claws; the other pair may have had three or four." So that the number of toe prints is variable in *H. Hardingi*, but it better represents the type of the genus than *H. Logani*.

Sir William's description of *H. Hardingi* is as follows ("Airbreathers," p. 8): "Dr. Harding found on one of these slabs a very distinct series of footprints, each with four toes and a trace of the fifth."

As the stride in *H. Hardingi* was five and a half inches, the track was probably that of an animal more than twice this length, *i. e.*, more than a foot long. The width of the track was two and a half inches.

In this species the print of the inner pair of toes was faint, indeed as regards the fore foot there was not any print of the first digit. There were, especially as regards the fore foot, three master toes, which always made a strong impression; in the hind foot this preponderance of the three central digits is not so marked, but still it is observable. The absorption, or weakening of the side toes, was thus in progress in these early forms. This process, if continued mainly in the forefoot, would in time give a species which would have the characters of Asperipes, in which the forefoot shows only three toe marks, but the hind retains five, and a form of footprint, not unlike that of the hind foot of *Hylopus Hardingi*.

The tendency to this absence of the print of the outer toes is seen in the more advanced footmarks in the typical series of footprints of *H. Hardingi*, where only three toe marks can be observed in the print of the fore foot.

In examining the track of this animal in detail, it will be seen that the creature had the habit of placing the hind foot directly behind the fore foot in walking, so that the two prints made by these feet were just clear of each other. An exception is seen

in the first track of the series where the print of the hind foot overlaps that of the fore foot; and a partial exception is seen in the second pair of footprints where the third digit is flexed, apparently by coming in contact with the fore foot before that had been removed to make another step. In the succeeding footsteps of the series it will be observed that the toes are not bent, for in these cases the two feet did not interfere.

The reduction in the number of the toe marks of the hind foot in such ungulate forms of moderate size as Hylopus cannot be traced to forms with fewer toes, for though there are several genera that possess five toes on the hind foot, I know of no genus hitherto described with four, except the blunt-toed genus Nanopus. But in species of a smaller size, Ornithoides presents us with a form in which the three master toes of each foot, only, are represented in the foot mark. Further than this the reduction in the number of digits seems not to have gone; at least the author is unacquainted with any Carboniferous species having a smaller number of toe prints than three.

In offering conjectures about the known animals which might be represented by these footmarks, Sir William Dawson, in his "Airbreathers," compares *H. Logani* to Dendrerpeton, but in his latter work, in the Transactions of the Royal Society of Canada, he favors the view that the Microsauria, notably Hylerpeton and Hylonomus, are the creatures which most likely left these footmarks. These Sir William separates from the Labyrinthodonts, as their teeth do not have the involved foldings of the enamel which Labyrinthodonts possessed. Other writers consider the Microsauria as a section of this order. In any case the footprints of Hylopus conform more to those of Amphibia than to those of Reptiles.

Since writing the above, I have received a letter from Prof. Geo. T. Kennedy, of King's College, Windsor, N. S., who has examined the original of *Hylopus Hardingi* in the museum of that college; and he states positively that there is no basis for a fifth toe in the print of the fore foot. The slight protuberence in the cast of that foot in one of the figures, he says merely represents one of numerous little projections scattered over the stone, and

is not actually related to the footprint alongside of which it occurs. This finally disposes of a possible fifth toe in the impression of the fore foot of Hylopus, as in neither *H. Logani* nor *H. Hardingi* can it be said to exist.

It is true that there is a fifth toe to the footprint of *Hylopus minor*, Dawson, but the heavy print of the sole in this marking does not conform to the ideal of Dawson's genus. On the whole, we conclude that five toemarks of the hind foot and four of the fore is the typical number for Hylopus.

ARTICLE VII.

# PHYSICAL ASPECT OF THE CAMBRIAN ROCKS IN EASTERN CANADA, WITH A CATALOGUE OF THE ORGANIC REMAINS FOUND IN THEM

OBSERVED AND DESCRIBED BY G. F. MATTHEW, LL. D., F. R. S. G.

Read April 5, 1904.

About twelve years ago the writer contributed to this Society a "List of the Fossils found in the Cambrian rocks in and near St. John." Prefixed to this list was a synoptical view of the groups of Cambrian strata in this district, with statements of their approximate thickness; four sections were given. See Bulletin X, page xv.

These sections form the basis of the estimates of the thickness of the Cambrian rocks in the St. John basin, and of the nature of the sediments of which the Cambrian system here is composed. Other sections, showing further details of the strata and comparing them with Cambrian rocks in other countries, will be found in the Transactions of the Royal Society of Canada, Vol. VIII, Sec. iv, pp. 123-130, and Vol. VII, Sec. iv, p. 142.

The range of the several species of animals that are found in the Cambrian of this district is shown in the same Transactions, Vol. V, Sec. iv, p. 161; Vol. X, Sec. iv, p. 16, and a full table of the species in Vol. XI, Sec. iv, pp. 113-119.

Since the list first above referred to was published, many additions have been made to the Cambrian faunas of this region, and studies have been extended over a wider field, and the time has now come when a more general review of the Cambrian deposits can be profitably made. The Atlantic seaboard of America has in the meantime been the field of study of a number of noted geologists, both those connected with governmental geological surveys, and of those who are students from universities, as well as of

others who are amateurs. In this way a considerable fund of knowledge has been accumulated, which helps to a better understanding of the problems involved in the study of the Cambrian rocks.

For a thousand miles along the Atlantic coast of North America the Cambrian sediments show a remarkable uniformity, both in the composition of the materials that form the strata, and in the similarity of the succession of members of which these stratified deposits are composed.

The same physical causes appear to have operated with much uniformity throughout Cambrian time along this coast from Massachusetts to Newfoundland, giving rise to a parallel series of strata in all the undoubted Cambrian districts.

As the following remarks are based on the conditions in explored Cambrian areas, it may be said that these are five in number, viz., Eastern Massachusetts, Southern New Brunswick, the Southeastern side of Nova Scotia, Cape Breton Island, and the peninsula of Avalon, in Newfoundland.*

Of the Cambrian age of portions of the rocks that have been referred to this system in Nova Scotia, some doubt may be expressed, for though large areas in that province have been referred to the Cambrian, and have been closely studied by capable geologists, no distinctively Cambrian fossils have been found. And the enormous thickness claimed for the quartzites would seem to imply that their base would have come within the region of severe metamorphism, if not of fusion, since their deposition. It is far in excess of the known thickness of strata in the undoubted Cambrian areas to northwest and northeast of them. Also no beds similar to the Basal Cambrian as known in the areas to the northwest and northeast, have been found at the base of the Cambrian in the peninsula of Nova Scotia. It seems, therefore, not impossible that this Nova Scotia Cambrian may include a part or the whole of some more ancient system.

Confining our attention to the areas where Cambrian fossils have actually been found, we note throughout this North Atlantic

* There is another area in northwestern New Brunswick, but neither the succession of members nor the faunas can be fully paralleled with those above named; it is therefore not considered in this account.

region the prevalence of volcanic deposits, or of red and green mud beds, in the initial period of Cambrian time. If the former are not actual lava flows, or the cores of old volcanic cones and ridges, they are the compacted ashes, mud and stones from such a source.

Resting on these volcanic deposits, though sometimes intercalated with them, are beds of sand and mud that easily show their relation to such a source as the volcano, by the fact that this sand consists largely of feldsphatic particles, while the mud beds are pale green, or red accumulations of volcanic dust, that have fallen into or been swept into the sea. Hence it would appear that while the first volcanic eruptions occurred over land surfaces, the land soon sank, and the later ones were thrown into the sea. It is in the levigated volcanic material thus thrown into the sea, or swept into it by rivers, that we meet with the earliest organic remains of the Cambrian time. These levigated deposits are chiefly in the Etcheminian terrane, and contain a very ancient group of Cambrian organisms. They also exhibit a cycle of deposits corresponding to that of the St. John terrane above them, for they have in the middle coarse sandy sediments, that separate two groups consisting largely of mud-beds; of these the lower has conglomerates and sandstones intercalated, while the upper are found to contain flaggy sandstones.

The principal sandstones, however, are in the middle member, which is comparatively barren of fossils, but contains much diffused hematite, giving the rock a markedly red color. These beds also, like those of the corresponding stage of the St. John terrane, frequently show ripple-marked layers replete with worm burrows, worm trails, and other marks of a shallow-water origin.

The oscillations of land and sea in this earlier part of Cambrian time in the areas of Southern New Brunswick and Cape Breton exhibit the following succession of conditions:

1st.—An emerged region that became loaded with volcanic deposits—lava, ashes and scoria.

2nd.—A sinking of the earth's crust, so that later ejections were cast into the sea, and the wash from the still emerged surfaces added to the accumulating deposit.

3rd.—A moderate elevation of the crust bringing the affected area near the sea level.

4th.—Renewal of the subsidence, with prevalence of more tranquil conditions than in the second stage, and a longer continuance of these conditions.

This period closes Etcheminian time, and there is a break, more or less distinctly marked between it and the later Cambrian. In New Brunswick there is a sandstone or a quartzite at the beginning of the latter, with a decided change in the color and aspect of the sediments, and in Cape Breton a conglomerate marks the transition to the later terrane. In Newfoundland the conglomerate base is more faintly marked in the west (Smith Sound), but sufficiently distinct in the east (Conception Bay). The reverse conditions of surface distribution prevail in Massachusetts, where fine sediments are found in the eastern part ( Boston ) but conglomerates are found on the west side of the area ( Attleboro', ) As previously remarked. the Etcheminian terrane has not been found on the mainland of Nova Scotia, where gray quartzites appear to be the oldest sediments

In the outer areas of the Cambrian rocks of the Atlantic coast the Etcheminian terrane is easily traced by the prevailing red color, as well as by its fossils. In this outer-zone fine slates prevail, and there are beds of limestone as may be seen in the Massachusetts and Newfoundland areas. In the inner zone (New Brunswick and Cape Breton) the sediments are coarser and limestones are wanting; it is in this inner zone that a middle member of sandstones and flags is most distinctly marked.

The organic remains of this middle member are similar to those of the lower sediments, so that the Etcheminian rocks have only two faunas, an upper and a lower. The volcanic rocks beneath them have yield a scanty fauna, which may not be more than a sub-fauna of the Lower Etcheminian. More material is required to determine the importance of this fauna.

So far as the St. John terrane is concerned, it is clear that the basins we have now are but fragments of deposits that have been spread over large areas of the Atlantic coast, and there may be extensive tracts occupied by slates and flags so far metamorphosed that Cambrian fossils cannot be recognized. The materials which

make up the flags and slates of the Johannian division (see below) glisten with water-born particles of mica, the sands are of uniform texture, and there are no traces of shore lines, though shallow water beds abound.

Also the Bretonian division, with its fine grained dark gray mud beds holding graptolites, and the perfect preservation of its delicate organisms, indicate the presence of a water-cushion of considerable depth above its muds, when these were being deposited, a cushion which we can hardly think was less than 1,000 feet deep. But a sea of this depth would have covered a wide area along the Atlantic coast, and we therefore infer that the known basins of Cambrian rock are but small fragments of the wide spread mantle of sediments that covered this region at the beginning of Ordovician Time.

The group of organic remains of the outer zone of the Etcheminian rocks appears to differ widely from that of the inner. This may be because they do not come from the same time-horizon; but it seems more likely to be due to some physical cause, either difference in the depth of the sea in the two zones, or paucity or abundance of sediment in the waters, or difference of temperature of the sea water in the two zones. Whatever the cause, Olenelloid trilobites have not been recognized in the strata of the inner zone, while they are characteristic of the faunas of the outer zone.

In the following catalogue the several districts where the fossils described in it were found are indicated by letters in the fourth column, viz.:

A is eastern Massachusetts (Boston to Attleboro'). No fossils from this are mentioned, because the author's work did not extend there.

B is southern New Brunswick. The numbers following indicate the basin of this area where the fossil was found, numbered from N. W. to S. E. These basins once united, have been separated by crustal movements and great denudation.

C is the peninsula of Nova Scotia. No characteristic fossils are known from this area.

D is Cape Breton. The basins of Cambrian rocks are indicated as those of New Brunswick by numbers.

E is the area of Avalon in Newfoundland. The more important basins are indicated by numbers.

N is the St. Lawrence valley area, from which a few fossils are named.
W is the Cambrian area of Mt. Stephen, in the Canadian Rocky Mountains.

The date of publication of the several species and varieties is indicated in the first column.

In order to make this catalogue more useful for reference. and so that it may serve as an index to the author's papers, the names of the species, etc., are arranged alphabetically in the several classes, and the place of publication is shown in brief, thus:

R. S.= Transactions of the Royal Society of Canada.
S. R.= Report on the Cambrian Rocks of Cape Breton, Geological Survey of Canada, 1903.
N B.= Bulletin of the Natural History Society of New Brunswick.
N. Y.= Transactions of the New York Academy of Sciences.
C. R.= Canadian Record of Science, Montreal.
Acad. Geol.= Acadian Geology, Sir J. W. Dawson.
Pal. Foss.= Palæozoic Fossils of E. Billings.
A. J. S.= American Journal of Science and Arts.
Pal. N. Y.= Palæontology of New York, Jas. Hall.
Quar. Jour. Geol. Soc.= Quarterly Journal of the Geological Society of London.
Geol. Mag.= Geological Magazine, London.
U. S. Geol. Survey = Bulletin of the U. States Geological Survey.
U. S. Nat. Mus.= Bulletin of U. States National Museum.
Can. Nat.= Canadian Naturalist, Montreal.
Geol. Verm.= Report on Geological Survey of Vermont, Adams.
Am. Geol.= American Geologist, Minneapolis.
Palæon. Scan.= Palæontologica Scandinavica, N. Angelin.

The last column of the list shows the faunas and sub-faunas that have been recognized in the Cambrian terranes in the Maritime Provinces of Canada, beginning with the oldest. The following symbols are used:

Co.—COLDBROOK TERRANE. This consists mostly, sometimes entirely of volcanic flows and ejectamenta, though in Cape Breton there are some shales and conglomerates.
E.—ETCHEMINIAN TERRANE. (Basal Cambrian).
E. 1.—Lower Etcheminian red and gray shales, etc.
E. 2.—Lower Etcheminian red sandstones. This and E. 1 contain the *Lower Etcheminian Fauna* (Holasaphus Fauna).
E. 3.—Upper Etcheminian red and gray shales, etc. This has the *Upper Etcheminian Fauna* (Holmia Fauna).
C.—THE ST. JOHN TERRANE. (Mostly Cambrian, but the uppermost beds are Ordovician).

C. 1.—*The Acadian Division*, has two faunas.
C. 1*a*.—A white-gray quartzite (no fossils).
C. 1*b*.—Greenish gray shales and sandstones (Protolenus Fauna).
C. 1 *c*1.—Gray shales (Paradoxides lamellatus sub-fauna).
C. 1 *c*2.—Gray shales (P.—— eteminicus sub-fauna).
C. 1*d*.—Dark gray shales (P.—— abenacus sub-fauna).
C. 1 *d*2.—Dark gray shales and limestone lentiles (Dorypyge sub-fauna).
C. 2.—*Johannian Division*, has one or more faunas.
C. 2*a* & *b*.—Gray quartzites, flags and slates (Upper Paradoxides Fauna).
C. 2*c*.—Gray flags and slates (Place of Olenus Fauna).
C. 3.—*Bretonian Division*, has four faunas.
C. 3*a*.—Dark gray slates, some flags (Parabolina Fauna).
C. 3*b*.—Dark gray slates, limestone lentiles and seams (Peltura Fauna).
C. 3*c*.—Dark gray and black slates (Dictyonema Fauna).
C. 3*d*.—Dark gray and black slates (Tetragraptus Fauna).
C. 3*e*.—Gray flaggy sandstones (Fauna of small brachiopods, not distinctive).

It should be explained that the relative position of one of these assises is determined by the palæontology and not supported by the stratigraphy. In the St. John basin (B3 of the locality Column). *Paradoxides abenacus* is *clearly* subordinate to ( underlies ) *P. eteminicus*. But in Sweden the position of the representative species is reversed, for *P. Tessini* there is below *P. exsulens*. In the Kennebecasis basin (B2) at Hastings' Cove, the *P. eteminicus* fauna is wanting and the *P. abenacus* rests on an assise having a peculiar grouping of species ( Dorypyge sub-fauna ),which contains genera of a higher range in Sweden and North America than *P. Tessini* and *P. abenacus*.. The latter form of trilobite is usually found in dark gray or black shales, and it seems likely that habitat has much to do with its perplexing relation to other species and genera. It lived in deep and quiet waters, while the *exsulens-eteminicus* type preferred shallower water in which species with calcareous tests and shells were common.

The Dorypyge sub-fauna, also preferred shore or shallow-water conditions. These prevailed on the border of the Kennebacasis basin (B2) until a sinking of the land brought in a purely *P. abenacus* fauna. This fauna is included under the symbol of C1d2 given above, while C1d is the *P. abenacus* fauna of the St. John basin.

Another fauna of doubtful position is that marked C3e, which is placed as the highest fauna, because both at the east and west end of the St. John basin it is in the highest visible beds of the St. John terrane; hence it is thought that this fauna is of later origin than the others.

**Catalogue of Species, and varieties of Organic remains found in the Cambrian terranes of the Atlantic provinces of Canada, &c., described in the writer's publications, alphabetically arranged.**

| Year | Generic and Specific Name | Place of Publication | Locality | Horizon |
|---|---|---|---|---|
| | ALGAE. | | | |
| | Bythotrephis, Hall. | | | |
| 89 | B.—— antiqua, Brong..... | R. S. VII, 144, V, 1-3, | B. 3 | E. 1. |
| | Hydrocytium. | | | |
| 89 | H.——(?) siculum,.. .. .. | R. S. VII, 146, VI. 2, | B. 3 | C. 1*b*. |
| 89 | Microphycus, genus, .. .. | R. S. VII, 146, | | |
| 89 | M.—— catenatus, .. .. .. | R. S. VII, 146, V, 6*a*, *b*, | B. 3 | C. 1*b*. |
| | Oldhamia, Forbes. | | | |
| | O.—— sp., .. .. .. .. .. .. | Can. Rec., .. .. .. .. .. | B. 1. 3 | C. 1, *b*, $c^1$. |
| | Palæochorda, McCoy. | | | |
| 89 | P.—— setacea, .. .. .. .. | R. S. VII, 145, VI, 1*a*-*g*. | B. 3 | E. 1. |
| 89 | Phycoidella, gen., .. .. .. | R. S. VII, 144, | | |
| 89 | P.—— stichidifera, .. .. .. | R. S. VII, 144, V, 5*a*-*d*. | B. 3 | E. 1. |
| | PROTOZOA. | | | |
| | Globigerina, d'Orb. | | | |
| 95 | G.—— cambrica, .. .. .. .. | N. Y. XIV, 111, I, 5*a*-*c*, | B. 3 | C. 1*b*2. |
| | G.—— didyma, .. .. .. .. | " " " 7*a*, *b*. | B. 3 | " |
| | G.—— grandis, .. .. .. .. | " " " 6, | B. 3 | " |
| | G.——(?) turrita, .. .. .. | " " " 8*a*, *b*. | B. 3 | " |
| 89 | Monadites, gen., .. .. .. | R. S. VII, 147, | | |
| 89 | M.—— globulosus, .. .. .. | R. S. VII, 147, VII, 1*a*-*b* | B. 1 | E. 1. |
| 89 | M.—— pyriformis, .. .... | " " " 2*a*-*b*, | B. 1 | " |
| 89 | M.——urceiformis, .. .... | " " " 3, | B. 1 | " |
| 89 | Radiolarites, gen., .. .. .. | R. S. VII, 148, | | |
| 89 | R.—— ovalis, .. .. .. .. | R. S. VII, 148, VIII, 4, | B. 1 | E. 1. |
| | Orbulina, d'Orb. | | | |
| 95 | O.——(?) ingens, .. .. .. | N. Y. XIV, 110, I, 4,.. | B. 3 | C. 1*b*2. |
| " | O.—— intermedia, .. .. .. | N. Y. XIV, 110, I, 3, .. | B. 3 | C. 1*b*2. |
| " | O.——(?) ovalis, .. .. .. | " " " 2, .. | B. 3 | " |
| " | O.—— c f. universa, Lam., | N. Y. XIV, 109, I, 1, .. | B. 3 | " |
| | SPONGIDA. | | | |
| | Archæocyathus, Billings. | | | |
| 85 | A.——(?) pavonoides, .... | R. S. III, 29, V, 1*a*-*d*, | B. 3 | C. 1*c*1. |
| | Astrocladia, Zittel. | | | |
| 89 | A.——(?) elegans, .. .... | R. S. VII, 149, VII, 7, | B. 1 | C. 1*b*. |
| " | A.——(?) elongata, .. .. | R. S. VII, 149, VII, 6, | B. 1 | " |
| " | A.——(?) virguloides, .... | R.S. VII, 149, VII, 8*a*-*c* | B. 3 | " |
| 89 | Dichoplectella, gen.,.. .... | R. S. VII, 149, | | |
| 89 | D.—— irregularis, .. .. .. | R. S. VII, 149, VII, 9*a*-*b* | B. 1 | E. 1 C. 1*b*. |

| Year | Generic and Specific Name | Place of Publication | Locality | Horizon |
| --- | --- | --- | --- | --- |
| | Hyalostelia, Zittel. | | | |
| 89 | H.—— minima, .. .. .... | R. S. VII, 150, VII, 10, | B. 1 | E. 1. |
| | Plococyphia, Reuss, .. .... | | | |
| 89 | P.——(?) perantiqua, .... | R. S. VII, 148, VII, 5*a*-*b* | B. 1 | E. 1. |
| | Protospongia, Salter. | | | |
| 85 | P.——(?) minor, .. .. .. | R. S. III, 30, V, 2,.... | B. 3 | C. 1*c*. |
| | P.——(?) v. distans, .. .. | R. S. III, 30, V, 3,.... | B. 3 | C. 1*d*. |
| 95 | P.——(?) sp., .. .. .. .. | N. Y. XIV, 113, .. .... | B. 3 | C. 1*b*2. |
| | HYDROZOA. | | | |
| | Bryograptus, Lapworth. | | | |
| 95 | B.—— lentus, .. .. .. .. | N.Y. XIV, 270, XLVIIII 2*a*, *b*, .. .. , .. .. .. | B. 3 | C. 3*c*. |
| 1,92 | B.—— patens, .. .. .. .. | R. S. IX, 39; R. S. 10, 95, VII, 1*a*-*d*, .. .... | B. 3 | C. 3*b*. |
| 95) | B.——(?) retroflexus, Brögg? .. .. .. .. | N. Y. XIV, 271, .. .... | B. 3 | C. 3*b*. |
| 92 | B.—— spinosus, .. .. .... | R. S. X, 97, VII, 2*a*, *b*, | B. 3 | C. 3*b*, *c*. |
| | Callograptus, Hall. | | | |
| 95 | C.—— sp., .. .. .. .. .... | N. Y. XIV, 271, 2*a*-*b*, | B. 3 | C. 3*c*. |
| | Clonograptus, Hall. | | | |
| 92) | C.—— flexilis, Hall, .. .. | R. S. X, 97, .. .. .. .. | B. 3 | C. 3*d*. |
| 95 | C.—— proximatus, .. .... | N.Y. XIV, 265, XLVIII, 1*a*-*d*, .. .. .. .. .... | B. 3 | C. 3*c*. |
| | Dendrograptus, Hall, .. .. | | | |
| 85 | D.—— primordealis, .. .. | R.S. III, 31, V, 5, 5*a*, *b*. | B. 3 | C. 1*d*. |
| | Dichograptus, Salter. | | | |
| 92) | D.—— Logani, Hall,.. .. | R. S. X, 97, .. .. .. .. | B. 3. | C. 3*d*. |
| | Dictyonema, Hall. | | | |
| 92) | D.—— delicatulum, Dn. | R. S. X, 96, .. .. .. .. | B. 3 | C. 3*d*. |
| | D.—— flabelliforme, Eich.. | | | |
| 91 | v. Acadicum, .. .. .. | R. S. IX, 34, III, 1, 2, 3*a*, *b*, | B. 3 | C. 3*c*. |
| " | v. confertum, Brögg. .. | " " 36, .. .. .. | B. 3 | C. 3*b*, *c*. |
| " | v. Norvegicum, Kjer... | " " 37, .. .. .. | B. 3 | C. 3*c*. |
| 92) | D.—— quadrangulare, Hall | " X, 96, .. .. .. | B. 3 | C. 3*d*. |
| | Didymograptus, McCoy, .. | | | |
| 92) | D.—— indentus, Hall,.. .. | R. S. X, 99, .. .. .. .. | B. 3 | " |
| " | D.—— nitidus, Hall, .. .. | R. S. X, 98, .. .. .. .. | B. 3 | " |
| " | D.—— patulus, Hall, .. .. | R. S. X, 98, .. .. .. .. | B. 3 | " |
| " | D.—— narrow, threadlike, | R. S. X, 98, .. .. .. .. | B. 3 | " |
| " | D.——(?) sp. very narrow, | R. S. X, 98, .. .. .. .. | B. 3 | " |
| 85 | Protograptus, gen., .. .. .. | R. S. III, 31. | | |
| 85 | P.—— alatus, .. .. .. .. | R. S. III, 32, V, 6, .. .. | B. 3 | C. 1*d*. |
| | Retiograptus, Hall. | | | |
| 92) | R.—— tentaculatus, Hall, | R. S. X, 100, .. .. .. .. | B. 3 | C. 3*d*. |

| Yaer | Generic and Specific Name | Place of Publication | Locality | Horizon |
|---|---|---|---|---|
| | Tetragraptus, Salter. | | | |
| (92) | T.—— quadribranchiatus, Hall. | R. S. X, 98, | B. 3 | C. 3*d*. |
| | ECHINODERMATA. | | | |
| 93 | Crinoid? | R. S. XI, 87, XVI, 1, | B. 3 | C. 1*b*2. |
| | Eocystites, Billings. | | | |
| 68 | E.——primaevus, Bill, | Acad. Geol., 643, *f*. 220, | B. 3 | C. 1*c*1, 2, |
| | Platysolenites, Pander. | | | |
| (89) | P.—— antiquissimus, Eich. | R. S. VII, 150, VII, 11*a-c* | B. 3 | E. 3*a*. |
| (98) | Trochocystites, Barr? | R. S. 2nd, IV, 128, | B. 3 | C. 1*b*3 |
| | BRACHIOPODA. | | | |
| | Acrothele, Linnarsson. | | | |
| 02 | A.—— abavia, | N. B., IV, 398, XV*a-d*. 100, IV, 3*a*, *d*, 4*a*, *b*,. | D. 1 | E. 3*a-e*. |
| 99 | A.—— avia, | N. B. IV, 202, III., 1*a-h*, 396, XVI, 1*a-f*, 2*a*, *b*. | D. 1 | E. 3*d-e*. |
| 02 | m. puteis, | N. B. IV, 398, XV, 5*a*, *b*, 100, IV, 5*a*, *b*, | D. 1 | E. 3*d*. |
| 68 | A.——Matthewi, Hartt, | Acad. Geol., 644, *f*. 221, R. S. III, 39, V, 15, 15*a*. | D. 1 | C. 1*c*, *d*. |
| 95 | m. costata, | N. Y. XIV, 128, V, 9. | B. 3 | C. 1*b*2-5. |
| 85 | m. lata, | R. S. III, V, 17, 17*a*. | B. 3 | C. 1*b*. |
| 97 | m. multicostata, | R. S. 2nd, III, 168, | B. 2 | C. 1*d*. |
| 85 | m. prima, | R. S. III, 41, V, 16, 16*a*. | B. 3 | C. 1*b*. |
| 02 | A.—— proles, | N. B. IV, 400, XVI, 3*a-e* | D. 1 | E. 3*f*. |
| 01 | Acrothyra, gen., | N. B. IV, 303, *f*. 1-5, | | |
| 85 | A.——(?) inflata, | R. S. III, 33, V, 7, 7*a*, | D. 1 | C. 1*d*. |
| | v. ovalis, | R. S. 2nd, IV, 127, V, 4*a-c*, | D. 1 | C. 1*b*1, |
| 02 | A.—— proavia, | N. B. IV, 386, XIV, 2*a-g*, 3*a-f*, | D. 1 | E. 3*d*, *e*.. |
| 92 | m. crassa, | N. B. IV, 389, XIV, 5*a-c* | D. 1 | E. 3*e*. |
| 02 | m. prima, | N. B. IV, 389, XIV, 4*a-f* | D. 1 | E. 3*a*. |
| 02 | A.—— signata, | N. B. IV, 381, XIII, 2*a-e* | D. 1 | E. 1*b*. |
| 02 | m. orta, | N. B. IV, 385, XIII, 4*a-f* | D. 1 | E. 2*c*. |
| 02 | m. prima, | N. B. IV, 382, XIII, 1*a-g* | D. 1 | Co. |
| 02 | m. sera, | N. B. IV, 383, XIII, 3*a-f* | D. 1 | E. 1*c*. |
| 02 | m. tarda, | N. B. IV, 384, XVI, 1*a-d* | D. 1 | E. 1*c*, *d*. |
| | Acrotreta, Kutorga. | | | |
| 85 | A.—— Baileyi, | R. S. III, 36, V, 13, 13*a-c* | B. 1 | C. 1*c*2. |
| 02 | A.—— bisecta, | N. B. IV, 275, V, 5*a-g*; 394, S. R. XVI, 2*a-g*, | B. 3 / D. 1 | C. 3*c*. / C. 3*c*. |
| (95) | A.—— gemma, Bill? | Pal. Foss. I, 216, 201,*a-f*, N. Y. XIV, 126, | B. 3 | C. 1*b*1. |
| 93 | A.——gemmula, | R. S. XI, 87, XVI, 2*a-d*. | B. 3 | C. 1*b*2, 3. |
| 02 | A.—— papillata, | N. B. IV, 390, XV, 2*a-f*. | D. 1 | E. 1*d*. |
| 02 | v. lata, | N. B. IV, 391, XV, 3*a-c*. | D. 1 | E. 1*d*. |

| Year | Generic and Specific Name | Place of Publication | Locality | Horizon |
|---|---|---|---|---|
| 02 | m. prima, .. .. .... | N. B. IV, 391, XV, 1*a-c*. | D. 1 | Co. |
| 99 | A.—— proavia, .. .. .. .. | N. B. IV, 203, III, 2*a-f*. | D. 1 | E. 3*e*. |
| 02 | A.—— sipo, .. .. .. .. .... | N. B. IV, 406, XVIII 1, 2, .. .. .. .. .. .. .. | D. 1 | C. 3*d*. |
| 02 | A.—— cf. socialis, v. Seeb. | N. B. IV, 392, XV, 5*a-k* | D. 2 | C. 2*c*. |
| " | A.—— sp., .. .. .. .. .. .. | N. B. IV, 394, .. .. .. | D. 1 | E. 2*a*. |
| 92 | Billingsella, Hall. | | | |
| 95 | B.——retroflexa, .. .. .. | R. S. 2nd, I, 266, II, 1*a-c*; S. R. 148, X, 2*a-e*, .... | D. 1 | E. 2(*a*?) |
| 91 | Botsfordia, s. gen., .. .. .. | R. S. IX, 63, .. .. .. .. | | |
| 89 | B.—— pulchra, .. .. .. .. .. | R. S. VII, 151, VIII, 1*a-m*, 2*a-c*, .. .. .. .. | B. 1 | C. 1*b*. |
| | | R. S. XI, 90, XVI, 3*a-b*. | | |
| | Camarella, Billings. | | | |
| 92 | C.—— parva, Bill? .. .... | R. S. X, 103, VII, 9*a*, *b*. | B. 3 | C. 3*a*. |
| | Dalmanella, see Orthis. | | | |
| 93 | Discinopsis, gen., .. .. .. | R. S. XI, 114. | | |
| 85 | D.—— Gulielmi, .. .. .. | R. S. III, 37, V, 14, 14*a-c* | B. 3 | C. 1*c*1. |
| 03 | Eoobolus, s. gen., .. .. .. | R. S. 135. | | |
| 03 | E.—— equiputeis, .. .. .. | R. S. 139, VIII, 2*a-e*,.. | D. 1 | E. 2(*a*?) |
| " | E.—— discus, .. .. .. .. | R. S. 138, VIII, 3*a-d*,.. | D. 1 | E. 1*e*. |
| " | E.—— triparilis, .. .. .. | R. S. 136, VIII, 4*a-e*; XI, 1*a*, *b*, .. .. .. .. | D. 1 | E. 1*b*, *c*. |
| | Heterorthis, see Orthis. | | | |
| | Kutorgina, Billings. | | | |
| 99 | K.—— granulata, .. .. .. | N. B. IV, 189, I, 2*a-d*. | E. 1 | E. 3. |
| 85 | K.—— Latourensis, ...... | R. S. III, 42, V, 18, 18*a-c* | B. 3 | C. 1*c*2. |
| 85 | K.——(?) pterineoides, .. | R. S. III, 43, V, 19, | B. 3 | C. 1*c*1. |
| 98 | K.—— (?) sp., .. .. .... | R. S. 2nd, IV, 136, | B. 2 | C. 3*a*. |
| | Leptobolus, Hall, note on. | S. R. 105. | | |
| 99 | L.—— atavus, .. .. .. .. | N. B. IV, 200, II, 1*a-f*. | D. 1 | E. 3*d*, *e*. |
| 03 | m. tritavus, .. .. .. .. | S. R. 109, VI, 5*a-c*, .... | D. 1 | E. 2(*a*?) |
| 99 | L.—— collicia, .. .. .. .. | N. B. IV, 200, I, 3*a-e*,.. | D. 1 | E. 3*c*, *e*, *f*. |
| 03 | L.—— flumenis, .. .. .. | S. R. 189, XI, 7*a-f*, .... | D. 2 | C. 2*c*. |
| 91 | L.—— gemmulus, .. .. .. | R. S. IX, 41, XII, 8*a-c*. | B. 3 | C. 3*c*. |
| 85 | L.—— linguloides, .. .... | R. S. III, 34, V, 8, 8*a*, *b*. | B. 3 | C. 1*d*. |
| 02 | cf. linguloides, .. .. .. | S. R. 192, .. .. .. .... | D. 1 | C. 3*d*. |
| | L.—— grandis, .. .. .. .. | R. S. XI, 91, XVI, 7*a-c*. | B. 3 | C. 3*e*. |
| 98 | L.——(?) cf. Lingulella granvillensis, Walc.,.. | R. S. 2nd, IV, 128, .... | B. 3 | C. 1*b*. |
| | Lingulella, Salter. | | | |
| (93) | L.—— Billingsiana, Whit., | R. S. IV, 151, .. .. .. | E. 3 | C. 2*b*. |
| | L.——cf. Billingsiana, . .. | R. S. XI, 93, XVI, 6*a*, *b*. | B. 3 | C. 2*c*. |
| (95) | L.——(?) cælata, Hall,.. | Pal. N.Y. I, 290 LXXIX, 9*a-c*, .. .. .. .. .... | B. 3 | C. 1*b*1. |
| 00 | L.—— concinna, .. .. .. | N. B. IV, 273, V, 3*a-h*. | D. 1 | C. 3*a*. |
| 02 | L.——cf. Davidis, McCoy.. | N. B. IV, 407. | D. 1 | C. 2 C. 3*d*. |
| 85 | L.—— Dawsoni, .. .. .. | R. S. III, 33, V, 9*a-d*... | B. 3 | C. 1*c*, *d*. |

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|---|---|---|---|---|
| 95 | L.—— Howleyi, .. .. .. | R. S. 2nd, I, 259, I, 3*a*, *b*. | E. 3 | C. 2*c*. |
| | L.—— lævis, .. .. .. .. .. | R. S. IX, 39, XII, 4*a*, *b*. | B. 3 | C. 3*a*. |
| 00 | L.—— lens, .. .. .. .. .. | N. B. IV, 274, V, 2*a*, *b*. | D. 1 | C. 3*a*. |
| 02 | L.—— lepis, .. .. .. .. .. | N. B. IV, 408. | D. 1 | E. 1*c*, *e*. |
| 03 | L.—— longovalis, .. .. .. | S. R. 123, VII, 3*a*-*f*, .. | D. 1 | Co. |
| 03 | cf. longovalis, .. .. | R. S. 75, VII, 2,.. .. .. | D. 1 | C. 3*a*-*d*, |
| (93) | L.—— Nicholsoni, Call? | Quar. Jour. Geol. Soc. xxxiii, 657, | | |
| | | R. S. XI, 115, .. .. .. | B. 3 | C. 3*c*. |
| 90 | L.—— radula, .. .. .. .. | R. S. VIII, 147, XV, | | |
| 95 | L.—— Selwyni, .. .. .. .. | R. S. 2nd, I, 255, I, 1*a*, *b*; | | |
| | | S. R. VII, 1*a*-*c*, .. .. | D. 1 | E. 2(*a*?) |
| 99 | L.—— tumida, .. .. .. .. | N. B. IV, 200, I, 2*a*-*c*,.. | D. 1 | E. 3*e*. |
| | | 7*a*, *b*, 8*a*-*e*, .. .. .. .. | B. 3 | C. 2*c*. |
| 97 | L.—— sp., .. .. .. .. .. | R. S. 2nd, IV, 136, .... | B. 2 | C. 3*a*. |
| | Lingulepis, Hall. | | | |
| 91 | L.—— cuneata, .. .. .. .. | R. S. XI, 92, XVI, 5*a*, *b*. | B. 3 | C. 1*b*. |
| 99 | L.—— Gregwa, .. .. .. .. | N. B. IV, 199, I, 1*a*-*f* | D. 1 | E. 1*b*-*d*, |
| 03 | v. robusta, .. .. .. | S. R. 131, .. .. .. .. .. | D. 1 | E. 1*d*. |
| 03 | L.—— longinervis, .. .. .. | S. R. 133, VII, 6*a*-*g*, | D. 1 | E. 2*b*. |
| 89 | L.—— Martinensis, .. .. .. | R. S. VII, 155, VIII, 4. | B. 3 | C. 1*b*. |
| 03 | L.—— pumila, .. .. .. .. | S. R. 75, VII, 5*a*, *b*, .. | D. 1 | Co. |
| 95 | L.—— Roberti, .. .. .. .. | R. S. 2nd, I, 256, I, 2*a*, *b*. | D. 1 | E. 2(*a*?) |
| 90 | L.—— Starri, .. .. .. .. .. | R. S. VIII, 146, XV, | | |
| | | 5*a*-*c*, 6*a*-*b*, .. .. .. .. | B. 3 | C. 2*b*. |
| 03 | m. exigua, .. .. .. | S. R. 197, XIV, 3*a*-*d*. .. | D. 2 | C. 2*a*. |
| 91 | v. minor, .. .. .. .. | R. S. IX, 58, XII, 5*a*, *b*. | B. 2 | C. 2(*b*?) |
| 03 | L——var., .. .. .. .. | S. R. 193, XIV, 2*a*-*c*, .. | D. 2 | C. 2*b*. |
| 94 | Lingulobolus, gen., .. .. .. | R. S. 2nd, I, 260, .. .. | | |
| (94) | L.—— affinis, Bill, .. .. .. | R. S. 2nd, I, 261, I, 4*a*, *b*. | E. 3 | C. 2*c*. |
| 95 | v. cuneata, .. .. .. | R. S. 2nd, I, 262, I, 4*c*, *d*. | E. 3 | C. 2*c*. |
| | Linnarssonia, Walcott. | | | |
| (91) | L.—— Belti, Dav., .. .. .. | R. S. IX, 42, XII, 7*a*-*e*; | | |
| | | S. R. 209, XVI, 3*a*-*c*. | B. 3 | C. 3*c*. |
| 97 | m. magna, .. .. .. .. | R.S. 2nd, III, 169, I, *a*, *b*, | B. 2 | C. 1*d*. |
| (85) | L.—— misera, Bill., .. .. | R. S. III, 35, V, 12, | | |
| | | 12*a*-*c*, .. .. .. .. .. .. | B. 3 | C. 1*d*. |
| 68 | L.—— transversa, Hartt,.. | Acad. Geol., 644.. .. .... | | |
| | | R. S. III, 35, V, 11, 11*a*-*c* | B. 3 | C. 1*c*. |
| | | N. Y. XIV, 125, V, 1*a*-*c*. | B. 3 | C. 1*b*5. |
| | Monobolina, Salter. | | | |
| 91 | M.—— refulgens, .. .. .. | R. S. IX, 44, XII, 6*a*-*d*. | B. 3 | C. 3*c*. |
| | Obolella, Billings. .. .. .. .. | | | |
| (99) | O.—— atlantica, Walc., .. | R. S. 2nd, V, 70, .. .. | E. 1 | C. 1*b*1. |
| | O.—— cf. chromatica, Bill. | N. B. IV, 189, I. 1, .. | E. 1 | E. 3. |
| | O.—— gemmula, see Leptobolus. | | | |

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|---|---|---|---|---|
| (95) | O.—— nitida, Ford? .. .. | A. J. S. 3rd, V, 213; N. Y. XIV, 125, II 8*a*, *b*. .. .. .. .. .... | B. 3 | C. 1*b*. |
| 97 | O.—— sp., .. .. .. .. .. .. | R. S. 2nd, III, 170 .... | B. 2 | C. 1*d*. |
| 98 | O.—— sp., .. .. .. .. .. .. | R. S. 2nd, IV, 136, .. | B. 2 | C. 3*a*. |
| | Obolus, Eichwald. | | | |
| 89 | O.——(?) major, .. .. .. | R. S. VII, 155, VIII, 3, | B. 3 | E. 2*a*, *b*. |
| 95 | O.—— pristinus, .. .. .. | N. Y. XIV, 121, IV, 1*a-c* | B. 3 | C. 1*b*2. |
| | O.—— pulcher, see Botsfordia. | | | |
| 03 | O.—— torrentis, .. .. .. | S. R. 76, VIII, 1, .. .. | D. 1 | Co. |
| | O.—— refulgens, see Monobolina. | | | |
| 03 | O.—— sp., .. .. .. .. .. .. | S. R. 209, .. .. .. .. .... | D. 1 | C. 2*b*. |
| | Orthis, Dalman. | | | |
| (92) | O.—— Carausii, Hicks?.. | R. S. X, 102, VII, 7*a*, *b*. | B. 3 | C. 3*a*. |
| | O.——(Dalmanella?) Electra Bill., .. .. .. .. .. .. | | | |
| 92 | v. lævis, .. .. .. .. | R. S. X, 100, .. .. .. .. | B. 3 | C. 3*d*. |
| 92 | v. major, .. .. .. .. | R. S. X, 100, VII, 3*a-c*. | B. 3 | C. 3*d*. |
| " | O.—— Euryone, Bill? .... | R. S. X, 101, VII, 5,.. | B. 3 | C. 3*d*. |
| | O.—— lenticularis, Wahl., | .. .. .. .. .. .. .. .. .. | B. 3 | C. 1. |
| 91 | v. atrypoides, .. .. | R. S. IX, 48, XII, 11*a*, *b*. | B. 3 | C. 3*b*. |
| " | v. lyncioides, .. .. | R. S. IX, 49, XII, 10*a-c*. | B. 3 | C. 3*b*. |
| " | v. strophomenoides, | R. S. IX, 49, XII, 12*a*, *b*. | B. 3 | C. 3*b*. |
| | O.——(Heterorthis?) Menapiæ, Hicks. | | | |
| 92 | v. Acadica, .. .. | R. S. X, 101, VII, 6*a*, *b*. | B. 3 | C. 3*d*. |
| (92) | O.——orthambonites, Pand. | R. S. X, 101, VII, 4.. | B. 3 | C. 3*d*. |
| 95 | O.—— sp., .. .. .. .. .. .. | N. Y. XIV, 128, V, 10. | B. 3 | C. 1*b*1, |
| | Orthisina, d'Orbigny. | | | |
| 91 | O.—— Johannensis, .. .. | R. S. IX, 49, XII, 13*a-c*. | B. 3 | C. 3*a*. |
| 99 | Palæobolus, s. gen., .. .. | N. B. IV, 201. | | |
| 99 | P.—— Bretonensis, .. .. | N. B. IV, 202, II, 2*a-i*. | D. 1 | E. 3*d*. |
| 03 | P.—— lens, .. .. .. .. .. .. | S. R. 144, X, 1*a-f*, .. .. | D. 1 | E. 3*b*, *c*. |
| " | v. longus, .. .. .. .. | S. R. 146, VII, 4*a*, *b*,.. | D. 1 | E. 3*c*. |
| | Protorthis, Hall & Clarke. | | | |
| 68 | P.—— Billingsi, Hartt. .. | Acad. Geol., 644 *f*. 223; R. S. III, 43. .. .. .. | B. 3 | C. 1*c*, *d*. |
| 85 | P.—— Quacoensis. .. .... | R. S. III, 43, V, 20, 20*a-c* | B. 3 | C. 1*c*. |
| 96 | Protosiphon, gen. described | Geol. Mag., 4th, IV, 68, 1-4, .. .. .. .. .. .. R. S. 2nd, III, 170, .. .. | | |
| (98) | P.—— Kempanum, .. .. | R. S. 2nd, IV, 129, I, *a-f*. | B. 2 | C. 1*b* 3-4. |
| | Schizambon, Walcott. | | | |
| 00 | S.—— priscus, .. .. .. .. | N. B. IV, 227, V, 4*a-d*. S. R. 187, XI, 6*a-d*, .. | B. 3 D. 1 | C. 3*c*. |
| 95 | Sphærobolus, gen., .. .... | R. S. 2nd, I, 263. | | |

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|---|---|---|---|---|
| (95) | S.—— spissus, .. .. .. .. | Pal. Foss. II, pt. I, 66, 36a-c,.. .. .. .. .. .. | | |
| | | R. S. 2nd, I, 263, I, *5a-c*. | E. 3 | C. *2c*. |
| | Strophomena, Hall. | | | |
| 92 | S.—— atava, .. .. .. .. .. | R. S. X, 102, VII, *8a-f*. | B. 3 | C. *3a*. |
| 93 | Trematobolus, gen., .. .. .. | C. R. Jan. '93, 276, *1a-d*. | | |
| 93 | T.—— insignis, .. .. .. .. | R. S. XI, 88, XVI, *4a-d*. | B. 3 | C. *1b* 3-4. |
| | Westonia, s. gen., Walc., | | | |
| 00 | W.—— Escasoni, .. .. .. | N. B. IV, 270, V, *1a-i*, | D. 1 | C. *3b*. |
| | LAMELLIBRANCHIATA. | | | |
| | Modiolopsis, Hall. | | | |
| 02 | M.—— cf. solvensis, Hicks, | N. B. IV, 408, .. .. .. | D. 1 | C. *3c2*, |
| 99 | M.—— thecoides, .. .. .. | N. B. IV, 191, I, *7a-c*. | E. 1 | E. 3. |
| | PTEROPODA. | | | |
| | Creseis, Rank. | | | |
| 92 | C.—— corrugata, .. .. .. | R. S. X, 105, VII, *12a-b*. | B. 3 | C. *3d*. |
| " | C.—— minuta, .. .. .. .. | R. S. X, 105, VII, *11a-c*. | B. 3 | C. *3d*. |
| | Styliola LeSueur. | | | |
| 92 | S.—— primæva, .. .. .. .. | R. S. X, 104, VII, *10a, b*. | B. 3 | C. *3d*. |
| | GASTEROPODA. | | | |
| | Bellerophon, Montfort. | | | |
| 02 | B.—— Bretonensis, .. .. | N. B. IV, 409, XVIII, *4a-d*, .. .. .. .. .. .. | D. 1 | C. *3c2*. |
| 02 | B.—— insulæ, .. .. .. .. | N. B. IV, 409, XVIII, 3 | D. 1 | " |
| 02 | B.—— semisculptus, .. .. | N. B. IV, 410, XVIII, 5 | D. 1 | " |
| | Harttia, Walcott. | | | |
| 84 | H.—— Matthewi, Walc.,.. | U. S. Geol. Surv. Bul., 19, I, 6, .. .. .. .. | B. 3 | C. *1c*. |
| 85 | Parmophorella, s. gen.,.. .. | R. S. III, 59, .. .. .. .. | | |
| 68 | P.—— Acadica, Hartt, .. | Acad. Geol. 644, *f. 222*. | B.3 | C. *1c*¹, 2 |
| (99) | P.—— panpera, Bill. sp... | N. B. IV, 190, .. .. .. | E. 1 | E. 3. |
| | Platyceras, Conrad. | | | |
| 90 | P.—— apertum, .. .. .. .. | R. S. VIII, 132, XI, *4a-d*. .. .. .. .. .. .. | B. 3 | C. *1c*¹. |
| 99 | P.—— cymbula, .. .. .. .. | N. B .IV, 191, I, *6a-b*. | E. 1 | E. 3 |
| 99 | P.—— radiatum, .. .. .. | N. B. IV, 191, I, *5a, b*. | E. 1 | E. 3. |
| 99 | P.—— transversum, .. .. | N. B. IV, 191, I, *4a, b*. | E. 1 | E. 3. |
| 95 | Pelagiella, gen., .. .. .. .. | N. Y. XIV, 131, .. .. | | |
| 95 | P.—— atlantoides, .. .. .. | R. S. XI, 94, XVI, *8a, b*. | | |
| | | N. Y. XIV, 131, VI, *6a-c* | B. 3 | C. *1b*, 2, |
| 99 | Randomia, gen., .. .. .. | N. B. IV, 190. | | |
| 99 | R.—— Auroræ, .. .. .. .. | N. B. IV, 190, I, *3a-c* | D. 1 | E. 3. |
| 47 | Raphistoma, Hall, .. .. .. | | | |
| 98 | R.——(?) Kelliensis, .. .. | R. S. 2nd, V, 70, III, 4a, b, | D. 3 | C. *2b*. |

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|---|---|---|---|---|
| | Scenella, Billings. | | | |
| 99 | S.—— cf. reticulata, Bill .. | N. B. IV, 190, ...... | E. 1 | E. 3. |
| " | S.—— cf. retusa, Foord, .. | N. B. IV, 190, ...... | E. 1 | E. 3. |
| | CEPHALOPODA. | | | |
| | Orthoceras, Breyn. | | | |
| 92 | O.—— cf. Priamus, Bill.,.. | R. S. X, 106, VII, 13*a, b*. | B. 3 | C. 3*d*. |
| 92 | O.—— cf. Catulus, Bill., .. | R. S. X, 106, VII, 14*a-d*. | B. 3 | C. 3*d*. |
| | ANNELIDA. | | | |
| 99 | Byronia, gen., ........ | R. S. 2nd, V, 41. | | |
| 99 | B.—— annulata, ...... | R. S. 2nd, V, 42, I, 2,.. | W. | C. 3*b*. |
| | Coleoides, Walcott. | | | |
| | C.—— typicalis, Walc.? .. | U. S. Nat. Mus., XII, 37 | E. 1 | E. 3. |
| | Hyolithellus, Bill. | | | |
| (99) | H.——(?) flexuosus, Walc. | N. B, IV, 192, I, 9, .. | E. 1 | E. 3. |
| (95) | H.—— micans, Bill.? .... | R. S. XI, 94. ........ | B. 3 | C. 1*b*2. |
| | Hyolithes, Eichwald, (Camarotheca Diplotheca included). | | | |
| 85 | H (D)—— Acadica, .... | R. S. III, 54, VI, 6, 6*a*. | B. 3 | C. 1*d*. |
| " | v. crassa, ........ | R. S. III, 55, VI, 9, .. | B. 3 | C. 1*b*2. |
| (72) | H.——Americanus, Bill. .. | Can. Nat. 2nd, VI, 215, | N. | C. 1*b*3. |
| 85 | H (C)—— caudatus, .... | R. S. III, 53, VII, 5, 5*a*. | B. 3 | C. 1*d*. |
| 99 | H.—— carinatus, ...... | R. S. 2nd, V, 42, I, 5*a, b*. | W. | C. 3*b*. |
| 85 | H (C.)—— Danianus,.. .. | R. S. III, 49, VI, 11*a-c*. | B. 3 | C. 1*c*, 2*d*. |
| 93 | H.—— decipiens, ...... | R. S. XI, 96, XVI, 11a-*d*, .......... | B. 3 | C. 1*b*2. |
| (99) | H.—— excellens, Bill., .. | N. B. IV, 194, III, 3*a, b*. | E. 1 | E. 3. |
| 95 | H (C)—— gracilior, .... | N. Y, XIV, 130, VI, 3*a, b* | B. 3 | C. 1*b*3. |
| 85 | H (C)——gracilis, ...... | R. S. III, 50, VI, 2, 2*a-c*. | B. 3 | C. 1*d*. |
| 01 | m. gracillimus, .... | R. S. 2nd, VII, 109, *f*. 3*a, d*. | B. 3 | C. 1*c*. |
| 99 | H.—— Hathewayi, ...... | R. S. 2nd, V, 73, III, 5*a-d*, .......... | E. 3 | C. 1*b*. |
| 85 | H (D)—— Hyattiana,.... | R. S. III, 52, VI, 4, 4*a*. | B. 3 | C. 1*b*3. |
| 93 | H.——cf. obesus, Holm .. | R. S. XI, 96, ........ | B. 3 | C. 1*d*. |
| 95 | H.——cf. obtusa, Bill.,.... | Geol. Verm., II, 955, N. Y. XIV, 130, ...... | B. 3 | C. 1*b*3. |
| 85 | H.—— obtusata, ...... | R. S. III, 55, VI, 8, .. | B. 3 | C. 1*c*. |
| 95 | H.——cf. princeps, Bill.,.. | Can. Nat. 2nd, VI, 216, 4a, b, N. Y. XIV, 129, | B. 3 | C. 1*b*3. |
| 99 | H.—— rugosus, ........ | N. B. IV, 194, III, 4*a, b*. | E. 1 | E. 3. |
| 85 | H.—— sericea, ........ | R. S. III, 55, VI, 7, 7*a, b* | B. 3 | C. 1d. |
| 63 | H.——cf. tenuistriata, Lnrs. | S. R. 83, IX, 4*a. b*, .... | D. 1 | E. 2(*a*? |
| | Helenia, Walcott. | | | |
| 99 | H.——granulata, ...... | N. B. IV, 192, II, 7*a-e*. | E. 1 | E. 3. |
| | Orthotheca, Novak. | | | |
| 99 | O.—— bayonet, ........ | N. B. IV, 193, III, 1*a-f*. | E. 1 | E. 3. |
| 99 | O.—— corrugata, ...... | R. S.2nd, V, 42, I, 3, .. | W. 1 | C. 3*b*. |

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|---|---|---|---|---|
| 93 | O.—— cf. deGeeri, Holm.. | R. S. XI, 95, XVI, *9a-d.* | B. 3 | E. 3. |
| " | O.—— cf. Emmonsi, Ford. | R. S. XI, 95, XVI, 10, | B. 3 | E. 3. |
| 85 | O.—— micmac, . . . . . . . . | R. S. III, 51, VI, 3, *3a.* | B. 3 | C. 1*c-d.* |
| 99 | O.—— pugio, . . . . . . . . | N. B. IV, 193, II, *4a-d.* | E. 1 | E. 3. |
| 99 | O.—— sica, . . . . . . . . . . | N. B. IV, 193, II, *5a-c.* | E. 1 | E. 3. |
| " | mut., . . . . . . . . . . | N. B. IV, 193, II, *6a-b.* | E. 1 | E. 3. |
| 03 | O.—— sp., . . . . . . . . . . | S. R. 83, . . . . . . . . . | D. 1 | E1*a-d,* 2*b.* |
| 99 | Urotheca, gen., . . . . . . . . | R. S. 2nd, V, 40. | | |
| 99 | U.—— flagellum, . . . . . . | R. S. 2nd, V, 40, I, 1. . . | W. | C. 3*b.* |
| " | U.—— parva, . . . . . . . . | R. S. 2nd, V, 41, VII, 2, | W. | C. 3*b.* |
| " | U.—— pervetus, . . . . . . | N. B. IV, 192, I, 8, . . . . | E. 1 | E. 3. |
| 02 | U.—— sp., . . . . . . . . . . | N. B. IV, 411, XVII, 6, | D. 1 | C. 3*c*2. |
| | Volborthella, Sshmidt, '88, (Orthotheca probably belongs here). | | | |
| 89 | V.—— tenuis, . . . . . . . . | R. S. VII, 156, VIII, *5a-d,* . . . . . . . . . . . . . | B. 1 | E. 3 C. |
| | OSTRACODA. | | | |
| 96 | Aluta, gen., . . . . . . . . . . | N. Y. XV, 198. | | |
| 96 | A.—— flexilis, . . . . . . . . | N. Y. XV, 198, XV, 4, | B. 3 | C. 1*c*1. |
| | Beyrichia, McCoy. | | | |
| 98 | B.—(?) primæva, . . . . . . | R. S. 2nd, IV, 133, 1, *2a-c,* . . . . . . . . . . . | B. 3 | C. 1*b* 3-4. |
| 03 | B.—— triceps, . . . . . . . . | S. R. 219, XVI, *4a-c,*. . | D. 2 | C. 2*b.* |
| 85 | Beyrichona, gen., . . . . . . | R. S. III, 65. | | |
| 85 | B.—— papilio, . . . . . . . . | R. S. III, 65, VI, 20, *20a, b,*. . . . . . . . . . . . | B. 3 | C. 1*b*4. |
| 95 | B.—— rotundata, . . . . . . | N. Y. XIV, 136, VII, 2, | B. 3 | C. 1*b*2. |
| 85 | B.—— tinea, . . . . . . . . . . . | R. S. III, 66, VI, 21, | B. 3 | C. 1*b*4. |
| | | *21a, b;* XI, 97, . . . . | B. 3 | C. 1*b* 2-3. |
| 95 | B.—— triangula, . . . . . . | N. Y. XIV, 135, VII, 5, | | |
| 99 | Bradoria, gen., . . . . . . . . | N. B. IV, 204. | | |
| 85 | B.——(?) Acadica, . . . . | R. S. III, 66, VI, 22, *22a, b,*. . . . . . . . . . . . . | B. 3 | C. 1*c*1. |
| 93 | B.—— aurora, . . . . . . . . | R. S. XI, 98, XVII, *5a-c* | B. 3 | C. 1*b*1. |
| 95 | B.—— oculata, . . . . . . . . | N. Y. XIV, 136, VIII, *2a, b,*. . . . . . . . . . . . | B. 3 | C. 1*b*3. |
| 03 | B.——(?) ornata, . . . . . . | Can. Rec. 456, II, *4a-c,* | D. 1 | E. 1*c.* |
| 99 | B.—— rugulosa, . . . . . . . . | N. B. IV, 205, III, *3a-d,* | D. 1 | E. 1*d.* |
| 03 | mut., . . . . . . . . . . | S. R. 166, . . . . . . . . . . | D. 1 | E. 1*c.* |
| 99 | B.—— scrutator, . . . . . . | N. B. IV, 204, IV, *1a-c.* | D. 1 | E. 3*c.* |
| 99 | B.—— vigilans, . . . . . . . . | R. S. XI, 205, XVII, 2a-c | D. 1 | E. 3*c.* |
| | m. obesa, . . . . . . . . | Can. Rec. Sci., 455, . . | D. 1 | E. 1*b.* |
| | mut., . . . . . . . . . . | Can. Rec. Sci., 455, . . | D. 1 | E. 1*d.* |
| 03 | Bradorona, gen. described | Can. Rec. 444. | | |
| " | B.—— observator, . . . . . . | Can. Rec. 448, I, *15a-c,* | D. 1 | E. 1*d.* |
| ' | v. benepuncta, . . . . | Can. Rec. 449, I, 16, . . | D. 1 | E. 1*d.* |

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|---|---|---|---|---|
| " | m. lævis, | Can. Rec. 450, | D. 1 | E. 1*b*, 2*e*. |
| " | m. ligata, | Can. Rec. 451, I, 17, | D. 1 | E. 3*e*. |
| " | B.—— perspicator, | Can. Rec. 444, I, 8*a-d*, | D. 1 | E. 1*d*. |
| " | m .magna, | Can. Rec. 446, I, 11*a, b*. | D. 1 | E. 2*b*. |
| " | m. maxima, | Can. Rec. 445, I, 9*a, b*, | D. 1 | E. 1*c*. |
| " | m. major, | Can. Rec. 446, I, 10*a, b*, | D. 1 | E. 3*f*. |
| " | B.—— spectator, | Can. Rec. 447, I, 12*a-d*, | D. 1 | E. 1*b, d*. |
| " | acuta, | Can. Rec. 447, | D. 1 | E. 1*b*. |
| " | m. spinosa, | Can. Rec. 448, I, 13*a, b*. | D. 1 | E. 1*e*. |
| " | m. æquata, | Can. Rec. 448, I, 4*a, b*, | D. 1 | E. 3*d*. |
| " | Escasona, gen. described | Can. Rec. 457. | | |
| " | E.——?? ingens, | Can. Rec. 459, II, 7*c-c*, | D. 1 | Co. |
| 95 | E.—— ovata, | N. Y. XIV, 135, VII, 8, | D. 1 | C. 1*b*2. |
| 03 | E.—— rutellum, | Can. Rec. 458, II, 5*a-c*. | D. 1 | E. 3*f*. |
| " | E.——(?) vetus, | Can. Rec. 458, II, 6*a-b*. | D. 1 | E. 3*d*. |
| 85 | Hipponicharion, gen., | R. S. III, 64. | | |
| 93 | H.—— cavatum, | R. S. XI, 99, XVII, 3*a, b* | B. 3 | C. 1*b*1. |
| 85 | H.——eos., | R. S. III, 64, VI, 19, 19*a, b*. | B. 3 | C. 1*b*1. |
| 93 | H.—— minus, | R. S. XI, 99, XVII, 4*a, b*, | B. 3 | C. 1*b*3. |
| 02 | Indiana, gen. described, | Can. Rec. VIII, 460. | . | |
| 95 | I.—— fusiformis, | N. Y. XIV, 137, VIII, 3*a, b*, | B. 3 | C. 1*b*3. |
| 02 | I.—— lippa, | Can. Rec. 463, II, 10*a-d*. | D. 1 | E. 3*f*. |
| " | I.—— ovalis, | Can. Rec. 461, I, 8*a-c*. | D. 1 | E. 1*e*. |
| 97 | I.—— pyriformis, | R. S. 2nd, IV, 132, I, 3*a-c*, | B. 2 | C. 1*b* 3, 4. |
| " | I.—— robusta, | R. S. 2nd, IV, 132, I, 4*a-c*, | B. 2 | C. 1*b* 3, 4. |
| 95 | I.—— secunda, | N. Y. XIV, 136, II, 11*a, b*, | B. 2 & 3 | C. 1*b* 3, 4. |
| | Isochilina, T, R. Jones. | | | |
| 89 | I.——(?) Steadi, | R. S. VII, 160, VII, 13*a-c*, | B. 3 | C. 1*b*. |
| 89 | I.——(?) ventricosa, | R. S. VII, 159, VII, 12*a-d*, | B. 3 | C. 1*b*. |
| | Leperditia, Rauoult. | | | |
| 95 | L.——(?) minor, | N. Y. XIV, 138, VIII, 4*a. b*, | B. 3 | C. 1*b*3. |
| " | L.——(?) primæva, | N. Y. XIV, 138, VIII, 6*a, b*, | B. 3 | C. 1*b*3. |
| 03 | L.——(??) rugosa, | Can. Rec. 443, I, 7*a-c*, | D. 1 | E. 3*f*. |
| | Schmidtella, Ulrich, note on, | Can. Rec. 463, | | |
| 99 | S.——(?) acuta, | N. B. IV, 205, IV, 4*a-c*, | D. 1 | E. 3*e, f*. |
| 95 | S.—— (?) Cambrica, | N. Y. XIV, 137, VII, 10*a. b*, | B. 3 | C. 1*b*3. |
| 99 | S.——(?) pervetus, | N. B. IV, 206, IV, 3*a-c*, | D. 1 | E. 3*c*. |
| 02 | m. concinna, | Can. Rec. 464, | D. 1 | E. 1*d*. |

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|---|---|---|---|---|
| | PHYLLOPODA. | | | |
| | Aptychopsis, Barrande. | | | |
| 99 | A.—— terranovicus, | N. B. IV, 194, III, 5, | E. 1 | E. 3. |
| " | m. arcuata, | N. B. IV, 195, III, 6, | E. 1 | E. 3. |
| 85 | Lepiditta, gen. described, | R. S. III, 61, | | |
| 85 | L.—— alata, | R. S. III, 61, VI, 16, 16*a*, | B. 3 | C. 1*c*2. |
| 93 | L.—— auricuiata, | R. S. XI, 99, XVII, 2*a*, *b*, | B. 3 | C. 1*d*. |
| 85 | L.—— curta, | R. S. III, 62, VI, 17, | B. 3 | C. 1*b*3. |
| 93 | L.—— sigillata, | R. S. XI, 98, X, VII, 1, | | |
| | Stenotheca, Salter. | | | |
| 85 | S.—— concentrica, | R. S. III, 57, VI, 11; VIII, 133, | B. 3 | C. 1$d^1$. |
| 85 | v. radiata, | R. S. III, 57, VI, 12; VIII, 133, | B. 3 | C. 1*c*, *d*. |
| 85 | S.—— Hicksiana, | R. S. III, VI, 14, | B. 3 | " |
| " | S.—— nasuta, | R. S. III, 58, VI, 13, | B. 3 | C. 1*c*2. |
| " | S.—— triangularis, | R. S. III, 58, VI, 15, 15*a*; VIII, 134, | B. 3 | C. 1*c*2, *d*. |
| | TRILOBITA. | | | |
| 98 | Acantholonus, s. gen., | R. S. 2nd, IV, 142, | | |
| 98 | A.—— spiniger, | R. S. 2nd, IV, 142, II, 4*a-e*, | B. 2 | C. 3*b*. |
| | Agnostus, Brongniart, | N. Y. XV, 207, | | |
| 68 | A.—— Acadicus, | Acad. Geol. 665, *f*. 229, R. S. III, 70, VII, 5*a*, *b*, | B. 3 | C. 1*c*2. |
| 85 | v. declivis, | R. S. III, 70, VII, 6*a*, *b*, | B. 3 | C. 1$d^1$. |
| 03 | cf. v. declivis, | S. R. 223, | D. 2 | C. 3*b*. |
| 91 | A.—— bisectus, | R. S. IX, 50, XIII, 2*a*, *b*, | D. 1 | " |
| 03 | A.—— cf. cyclopyge, Tull. | S. R. 222, | D. 1 | " |
| (96) | A.—— Davidis, Salt., | N. Y. XV, 225, XVI, 6, | E. 2 | C. 1*d*2. |
| (96) | A.—— fallax, Linrs., | N. Y. XV, 214, | | |
| 85 | v. concinna, | R. S. III, 70, VII, 4*a-c*, | B. 3 | C. 1$d^1$. |
| | | N. Y. 15, 216, XV, 7*a-c*, 8*a*, *b*, | B. 3 | " |
| 96 | v. trilobata, | N. Y. XV, 216, XV, 9, | B. 3 | C. 1$c^1$. |
| 85 | v. vir., | R. S. III, 69, VII, 3, | B. 3 | C. 1$c^1$. |
| (96) | A.—— fissus, Lundg., | N. Y. XV, 230, XVI, 9*a*, *b*, | B. 3 | C. 1$d^1$. |
| 96 | v. trifissus, | N. Y. XV, 231, XVI, 10, | B. 3 | " |
| (96) | A.—— gibbus, Linrs, | N. Y. XV, 226, | B. 3 | C. 1$c^1$. |
| 85 | v. acutiloba, | R. S. III, 73, VII, 10, | B. 3 | C. 1$d^1$. |
| 85 | v. partita, | R. S. III, 68, VII, 2, 2*a*, *b*, | B. 3 | " |
| 96 | var., | N. Y. XV, 228, | B. 3 | " |
| (96) | A.—— lævigatus, Dalm. | | | |
| " | v. ciceroides, | N. Y. XV, 234, XVII, 2*a*, *b*, | E. 2 | " |
| " | v. mamilla, | N. Y. XV, 234, XVII, 3*c*, *b*, | E. 2 | C. 1$d^1$. |

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|---|---|---|---|---|
| 95 | var., .. .. .. .. .. .. | R. S. 2nd, III, 173, I, 7, | B. 2 | C. 1*d*2. |
| 96 | v. terranovicus, .. .. | N. Y. XV, 233, XVII, 1*a*, *b*, .. .. .. .. .. .. | E. 2 | C. 1*d*2. |
| 99 | A.—— montis, .. .. .. .. .. | R. S. 2nd, V, 43, I, 6,.. | W. | C. 3*b*. |
| (96) | A.—— Nathorsti, Brögg., | N. Y. XV, 229, .. .. .. | B. 3 | C. 1*d*1. |
| 96 | v. confluens, .. .. .. | N. Y. XV, 230, XVI, 9*a*, *b*, .. .. .. .. .. .. | B. 3 | " |
| 97 | mut., .. .. .. .. .. .. | R. S. 2nd, III, 171, I, 2, | B. 2 | C. 1*d*2. |
| (96) | A.—— nudus, Beyr., .. .. | N. Y. XV, 235, .. .. .. | E. 2 | C. 1*d*1. |
| 85 | A.—— obtusilobus, .. .. .. | R. S. III, 72, VII, 9, .. | B. 3 | " |
| (96) | A.—— parvifrons, Linrs., | N. Y. XV, 220; 132, XVI, 4*a*, *b*, .. .. .. .. | B. 3 | C. 1*d*, 1, 2. |
| | A.——cf. nepos, Brögg, .. | R. S. 2nd, III, 172, I, 5, | B. 3 | C. 1*d*2. |
| 85 | v. tessella, .. .. .. | R. S. III, 71, VII, 7*a*-*c*, | B. 3 | " |
| 96 | v. truncata, .. .. .. | N. Y. XV, 222, .. .. .. | B. 3 | " |
| (93) | A.——pisiformis, L., var. *a*, | R. S. XI, 59, XIII, 1*a*, *b*, | | |
| 98 | | R. S. 2nd, IV, 136, II, 1*a*-*c*, .. .. .. .. .. .. | B. 2 | C. 3*a*. |
| " | m. rugulosa, .. .. .. | R. S. 2nd, IV, 137, II, 2, | B. 2 | " |
| " | m. affinis, .. .. .. .. | R. S. 2nd, IV, 137, II, 3, | B. 2 | " |
| " | m. valida, .. .. .. .. | R. S. 2nd, IV, 137, .. .. | B. 2 | " |
| (96) | A.—— punctuosus, Aug.,.. | N. Y. XV, 232, XVI, 11, | E. 2 | C. 1*d*2. |
| 95 | var., .. .. .. .. .. .. | R. S. 2nd, III, 172, I, 3, | B. 2 | " |
| 85 | A.—— regulus, .. .. .. .. | R. S. III, 67, VII, 1*a*-*c*, | B. 3 | C. 1*c*1. |
| | A.—— rex., Barr., .. .. .. | | | |
| 96 | v. transsectus, .. .. | N. Y. XV, 214, XVI, 2, | B. 3 | C. 1*c*2. |
| | A.—— trisectus, Salt.,.. .. | | | |
| 00 | m. germanus, .. .. | N. B. IV, 279, .. .. .. | D. 1 | C. 3*b*. |
| | m. ponepunctus,.. .. | N. B. IV, 278, V, 8*a*-*c*, | D. 1 | " |
| 85 | A.—— umbo, .. .. .. .. .. | R. S. III, 71, VII, 8*a*, *b*, | B. 3 | C. 1*d*1. |
| 96 | mut., .. .. .. .. .. .. | N. Y. XV, 173, XVI, 6*a*, *b*, .. .. .. .. .. .. | B. 2 | C. 1*d*2. |
| | Agraulos, Corda. | | | |
| 86 | A.—— affinis, Bill., .. .. .. | R. S. IV, 153, 2, 2*b*,.. .. | E. 2 | C. 1. |
| | A.—— ceticephalus, Barr., | | | |
| 85 | v. carinatus, .. .. .. | R. S. III, 176, II, 2*a*, *b*, | B. 2 | C. 1*d*2. |
| 87 | A.—— Halliana, .. .. .. | R. S. V, 132, I, 2*a*-*m*,.. | B. 3 | C. 1*c*2. |
| 90 | A.——(?) holocephalus, .. | R. S. VIII, 138, XI, 5*a*-*d*, | B. 2 | " |
| 97 | A.——(?) nanus, .. .. .. | R. S. 2nd, III, 178, II, 5*a*, *b*, .. .. .. .. .. .. | B. 2 | " |
| " | A.——(?) pusillus, .. .. .. | R. S. 2nd, III, 178, II, 6*a*, *b*, , .. .. .. .. .. | B. 2 | " |
| " | A.—— Roberti, .. .. .. .. | R. S. 2nd, III, 177, II, 4*a*, *b*, .. .. .. .. .. .. | B. 2 | " |
| 86 | A.—— socialis, Bill., .. .. | R. S. IV, 151, 1, 1*a*, *b*,.. | E. 2 | C. 1. |
| 90 | A.——(?) Whitfieldiana, .. | R. S. V, 130, II, 1*a*-*f*.. R. S. VIII, 138, XI, 6*a*-*d* (*e*?) .. .. .. .. | B. 3 | C. 1*c*1. |
| | v. compressa, .. .. | R. S. V, 131, I, 1*g*-*i*, .. | B. 3 | " |
| 99 | Anadoxides, sub-gen., .. .. | N. B. IV, 142. | | |
| 02 | Angelina, sp., .. .. .. .. | N. B. IV, 413, XVIII, 8, | D. 1 | C. 3*c*2. |

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| | Anomocare, Angelin. | | | |
| 99 | A.——magnum, Brögg., var. | R. S. 2nd, III, 184, III, 5a-e, .. .. .. .. .. .. | B. 2 | C. 1d2. |
| (97) | A.—— tucer, Bill., .. .... | Geol. Verm. II, 951, f. 356 R. S. 2nd, III, 198, IV, 8, | N. | E. 3. |
| | Asaphellus, Callaway,.. .. | N. B. IV, .. .. .. .. .... | | |
| 02 | A.—— Homfrayi, Salt., var., .. .. .. .. .. .. | N. B. IV, 413, XVIII, 10a-e, .. .. .. .. .. .. | D. 1 | C. 3c2. |
| " | A.—— planus. .. .. .. .. .. | N. B. IV, 419, XVIII, 11, | D. 1 | " |
| | Atops, Emmons, a sub-gen, | R. S. 2nd, V, 88. | | |
| (99) | A.—— trilineatus, Emm., | R. S. 2nd, V, 89, IV, 8, | E. 3 | C. 1(d?) |
| | Avalonia, Walcott. | | | |
| 99 | A.—— plana, .. .. .. .. .. | R. S. 2nd, V, 81, IV, 7, | I. 3 | " |
| | Bathyuriscus, Meek. | | | |
| (99) | B.—— Howelli, Walc., .. | R. S. V, 50, .. .. .. .. | E. 3 | C. 3b. |
| 99 | B.—— pupa, .. .. .. .. .... | R. S. V, 51, II, 5, .. .. | W. | C. 3b. |
| (97) | B.—— senectus, Bill.,.. .. | R. S. III, 196, IV, 4,.. | N. | E. 3. |
| 95 | Bergerónia, s. gen., .. .... | N. Y. XIV, 146, .. .... | | |
| 95 | B.—— Acadica, .. .. .... | N. Y. XIV, 140, IX, 5, | B. 3 | C. 1b3. |
| 85 | B.—— articephala, .. .. .. | R. S. III, 65, VII, 14a, b, N. Y. XIV, 147, X, 5a, b, | B. 3 | " |
| 92 | B.—— elegans, W. D. Matthew, .. .. .. .. .. | N. B. Bull. 10, 25, f. 1... N. Y. XIV, 147, XI, 3a-e. | B. 3 | " |
| | Catadoxides, s. gen., .. .. | N. B. IV, 142. | | |
| | Conocephalites, Barrande, | | | |
| 99 | C.—— cf. (Conaspis), perseus, Hall, .. .. | R. S. 2nd, V, 46, II, 4.. | W. | C. 3b. |
| 91 | C.—— contiguus, .. .. .. | R. S. IX, 58, XIII, 14a, b | B. 3 | C. 3b. |
| (97) | C.—— miser, Bill., .. .... | R. S. 2nd, III, 200, IV, 7, 7a. .. .. .. .. .... | N. | E. 3. |
| 93 | C.—— sp., .. .. .. .. .. .. | R. S. XI, 110, XVII, 15a, b, .. .. .. .. .... | B. 3 | C. 3a. |
| | Conocoryphe, Corda. | | | |
| 84 | C.—— Baileyi, Hartt, .. .. | R. S. II, 111, I, 22-27; VIII, 135, XI, 10, .... | B. 1, 3 | C. 1c2. |
| " | v. arcuata, .. .... | R. S. II, 113, I, 23, 23b, | B. 3 | " |
| " | C.—— elegans, Hartt,.. .. | R. S. II, 115, I, 28-33,.. | B. 3 | " |
| " | v. granulata, .. .... | R. S. II, 116, I, 34. .. .. | B. 3 | " |
| 97 | C.—— pustulosa, .. .. .. | R. S. 2nd, III, 174, I, 8a, b, .. .. .. .. .... | B. 2 | C. 1d. |
| 84 | C.—— Walcotti, .. .. .. | R. S. II, 119, I, 36, 36b; VIII, 134, XI, 7a-c,.. | B. 3 | C. 1c1. |
| | Corynexochus, Angelin. | | | |
| 99 | C.—— Rœmingeri, .. .. .. | R. S. 2nd, V, 47, II, 3, | W. | C. 3b. |
| | Ctenocephalus, Corda. | | | |
| 84 | C.—— Matthewi, Hartt, .. | R. S. II, 103, I, 6-21, .. | B. 3 | C. 1c. |
| 84 | v. geminispinosus, Hartt (sp.).. .. .. | R. S. II, 106, I, 21, .. .. | B. 3 | " |

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|---|---|---|---|---|
| " | v. hispidus, | R. S. II, 106, I, 7, | B. 3 | C. 1c2. |
| " | v. perhispidus, | R. S. II, 107, I, 12, | B. 3 | C. $1c^1$. |
| | Ctenopyge, Linnarsson. | | | |
| 91 | C.—— Acadica, | R. S. IX, 57, XIII, 13*a, b* XI, 109, XVII, 13*a-e*, | B. 3 | C. 3*b*. |
| " | C.—— flagillifer, Ang., | R. S. IX, 56, XIII, 12*a, b*, | B. 3 | " |
| " | C.—— pecten, Salt., | R. S. IX, 58; S. R. 229, XVII, 5*a, b*, | B. 3, C. 1 | " |
| | Cyclognathus, s. g., Linrs., | | | |
| 92 | C.—— rotundifrons, | R. S. X, 107, VII, 16*a, b*, | B. 3 | C. 3*d*. |
| | Dolichometopus, Angelin. | | | |
| 97 | D.—— Acadicus, | R. S. 2nd, III, 185, III, 6*a-d*, | B. 2 | C. 1*d*. |
| 99 | D.—— occidentalis, | R. S. 2nd, V, 49, II, 2. | W. | C. 3*b*. |
| | Dorypyge, Dames. | | | |
| 99 | D.—— Dawsoni, | R. S. 2nd, V, 56, III, 1, | W. | C. 3*b*. |
| 97 | D.—— horrida, | R. S. 2nd, III, 190, IV, 3*a, b*, | B. 2 | C. 1*d*. |
| (97) | D.—— parvula, Bill., | R. S. 2nd, III, 197, IV, 5, 5*a*, | N. | E. 3. |
| | D.—— quadriceps, H. & W. v. valida, | R. S. 2nd, III, 189, IV, 2*a, b*, | B. 2 | C. 1*d*. |
| 97 | D.—— Wasatchensis, H. & W., v. Acadica, | R. S. 2nd, III, 188, IV, 1, | B. 2 | " |
| | Ellipsocephalus, Zenker, | | | |
| " | E.—— galeatus, | R. S. XI, 103, XVII, 7*a-e* | B. 3 | C. 1*b*3. |
| " | E.—— grandis, | R. S. XI, 105, XVII, 6*a-c* | B. 3 | C. 1*b*2. |
| 87. | E.—— cf. polymetopus, Linrs., | R. S. V, 129, II, 8*a-c*. | B. 3 | C. $1b^1$. |
| | Erinnys, Salter. | | | |
| (99) | E.—— breviceps, Ang., | R. S. 2nd, V, 91, IV, 9, | E. 3 | C. 1(*d*?) |
| | Euloma, Angelin. | R. S. X, 108, | | C. 1*d*. |
| | Eurycare, Angelin. | | | |
| 93 | E.—— spinosum, | R. S. XI, 106, XVII, 14*a-c*, | B. 3 | C. 3*b*. |
| | E.——cf. angustatum, Ang. | | B. 3 | " |
| 95 | Holasaphus, gen., | R. S. 2nd, I, 268; S. R. 174, | | |
| " | H.—— centropyge, | R. S. 2nd, I, 268, II, 4*a, b*; S.R. 174, X, 3*a-c*, | D. 3 | E. 2(*a*?) |
| | Leptoplastus, Angelin. | | | |
| 91 | L.—— latus, | R. S. IX, 54, XIII, 10*a-c*, | B. 3 | C. 3*b*. |
| | var., | R. S. IX, 55, XIII, 11, | B. 3 | " |

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|---|---|---|---|---|
| | Liostracus, Angelin. | | | |
| ·87 | L.—— Ouangondianus, Hartt sp., | R. S. V, 138, I, *4a, l-q*, II, *7a-f*, | B. 3 | C. 1*c*2, *d*2, |
| 87 | v. aurora (sp. Hartt) | R. S. V, 139, II, *7a-f*, | B. 3 | C. 1*c*. |
| 87 | v. gibba, | R. S. V, 140, I, *4h-k*, | B. 3 | C. 1$c^1$. |
| 87 | v. immarginata, | R. S. V, 139, I, *4b-d*, | B. 3 | C. 1*c*. |
| 87 | v. plana, | R. S. V, 140, *4e-g*, | B. 3 | C. 1$c^1$. |
| 87 | L.—— tener, Hartt sp., | R. S. V, 137, I, *3a-c* | B. 3 | " |
| ·95 | v. acuminata, | R. S. XI, 118, | B. 3 | C. 1*c*2. |
| " | v. lævis, | R. S. XI, 118, | B. 3 | C. 1*d*. |
| ·97 | L.—— validus, | R. S. 2nd, III, 179, II, *7a, b*, | B. 2 | " |
| | Metadoxides, Bornemann. | | | |
| 99 | M.—— magnificus, | N. B. IV, 137, III. | E. 3 | C. 1*b*. |
| | Microdiscus, Emmons. | | | |
| 96 | sub-sections of | N. Y. XV, 235-237. | | |
| | M.—— bellimarginatus, S. and F. | | | |
| 99 | m. insularis, | R. S. 2nd, V, 75, | D. 3 | E. 3. |
| 68 | M.—— Dawsoni, Hartt, | Acad. Geol. 564, *f*. 228. | B. 3 | C. 1$c^1$. |
| 85 | M.—— precursor, | R. S. III, 75, VII, 13, | B. 3 | C. 1*c*2. |
| (96) | M.—— pulchellus, Hartt, | R. S. 2nd, III, 74, VII, *12a-c*, N. Y. XV, 242, XVII, *8a-f*, | B. 3 | C. 1*d*. |
| ·(96) | M.—— punctatus, Salt., | N. Y. XV, 244, | E. 3 | C. 1*d*2. |
| 96 | M.—— Schucherti, | Am. Geol. July, '96, no fig., N. Y. XV, 238, XVII, *4a, b*, | N. | E. 3. |
| 95 | Micmacca, gen., | N. Y. XIV, 141. | | |
| 99 | M.—— angimargo, | R. S. 2nd, V, 80, IV, 6, | E. 3 | E. 3. |
| 95 | M.—— Matthevi, | N. Y. XIV, 141, X, *1a, b*, | B. 3 | C. 1*b*3. |
| " | M.——(?) plana, | N. Y. XIV, 143, XI, *2a, 3b*, | B. 3 | " |
| 95 | M.—— recurva, | N. Y. XIV, 142, X, *2a, b*. | B. 3 | " |
| " | M.—— VanIngeni, | N. Y. XIV, 142, XI, *va. b*. | B. 2, 3 | C. 1*b*3. |
| 99 | M.—— Walcotti, | R. S. 2nd, V, 79, IV, *5a-d* | E. 3 | E. 3. |
| 99 | Neolenus, gen., | R. S. 2nd, V, 52. | | |
| ·(99) | N.—— serratus, Roeminger | R. S. 2nd, V, 53, | W. | C. 3*b*. |
| 99 | N.—— granulatus, | R. S. 2nd, V, 55, II, *1a-c*. | W. | " |
| | Ogygia Brongn. (Ogygopsis) (Walcott). | | | |
| ·(99) | O.—— Klotzi, Roemin. | R. S. 2nd, V, 58, | W. | C. 3*b*. |
| | Oryctocephalus, Walcott. | | | |
| 99 | O.—— Walkeri, | R. S. 2nd, V, 60, III, 2, | W. | C. 3*b*. |

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|---|---|---|---|---|
| | Parabolina, Salter. | | | |
| 00 | P.—— Dawsoni. .. .. .. .... | N. B. IV, 282, V, *6a-f*,.. | D. 1 | C. 3*b*. |
| 91 | P.—— grandis, .. .. .. .... | R. S. IX, 52, XIII, 7, | B. 3 | " |
| | P.—— heres, Brögg., .. .. | | | |
| 91 | v. lata, .. .. .. .. .... | R. S. IX, 51, XIII, *6a-f*, | B. 3 | C. 3*b*. |
| (91) | P.—— spinulosa, Wahl.,.. | R. S. IX, 51, XIII, *5a-d*, | B. 3 | C. 3*a*. |
| | Parabolinella, s. gen., Brögg. | | | |
| 00 | P.—— cf. limitis, Brögg.,.. | N. B. IV, 412, .. .. .. | D. 1 | C. 3*c*2. |
| 92 | P.—— posthuma, .. .. .. | R. S. X, 107, VII, 15*a*, *b*, | B. 3 | C. 3*d*. |
| 00 | P.—— quadrata, .. .. .. | N. B. IV, 411, XVIII, 7, | D. 1 | C. 3*c*2. |
| | Paradoxides, Brongniart. | | | |
| 85 | P.—— Abenacus, .. .. .. | R. S. III, 78, .. .. .. | B. 3 | C. 1*d*. |
| 97 | mut., .. .. .. .. .. .. | R. S. 2nd, III, 175, I, *9a-c*, .. .. .. .. .. .. | B. 2 | C. 1*d*. |
| 97 | form 2, .. .. .. .. .. | R. S. 2nd, III, 175, II, *1a-d*, .. .. .. .. .... | B. 2 | " |
| 82 | P.—— Acadicus, .. .. .. | R. S. I, 103, .. .. .. .. | B. 3 | C. 1*c*2. |
| 85 | v. suricus, .. .. .. .... | R. S. III, 77, .. .. .... | B. 3 | " |
| 82 | P.—— Eteminicus, .. .. .. | R. S. I, 92, .. .. .. .. | B. 3 | " |
| " | v. breviatus, .. .... | R. S. I, 99, .. .. .. .. | B. 3 | " |
| " | v. malicitus, .. .... | R. S. I, 101, .. .. .. .. | B. 3 | " |
| " | v. quacoensis, .. .. | R. S. I, 102, .. .. .. .. | B. 3 | " |
| " | v. suricoides, .. .... | R. S. I, 97, .. .. .. .. | B. 3 | " |
| 78 | P.—— Forchhammeri, Ang. | Palæon. Scan. p. 2, pl. II, N. B. IV, 379; S.R. pp. 47, 48, | D. 3 | C. 2*b*. |
| 68 | P.—— lamellatus, Hartt, .. | Acad. Geol. 656, R. S. I, 105; VIII, 135, XI, 9, .. .. .. .. .. | B. 3 | C. 1*c*1. |
| 85 | v. loricatus, .. .. .. | R. S. I, 106, IX, 19, .. | B. 3 | C. 1*c*. |
| 85 | P.—— micmac, .. .. .. .... | R. S. III, 80, .. .. .... | B. 1, 3. | " |
| 82 | v. pontificalis, .. .. | R. S. I, 102, IX, 15, 15*a*, R. S. VIII, 136, XI, 8, | B. 3 B. 3 | C. 1*c*2. C. 1*c*1. |
| 87 | P.—— Regina, .. .. .. .... | R. S. V, 115, III, .. .. | B. 3 | C. 1*c*. |
| 03 | Paradoxidoid trilobite,.. .. | S. R. 176, XI, *1a-e*,.. .. | D. 1 | E. 2(*a*?) |
| | Peltura, M. Edwards. | | | |
| (03) | P.—— scarabeoides, Wahl. | S. R. 230, .. .. .. .. .. | B. 2 | C. 1 C. 3*b*. .. |
| 95 | Protagraulos, gen.,.. ... .. | N. Y. XIV, 138. | | |
| 95 | P.—— priscus, .. .. .. .. | N. Y. XIV, 139, IX, 1, | B. 3 | C. 1*b*3. |
| | Protopeltura, s. gen., Brögg | | | |
| | P.—— acanthera, Ang. | | | |
| 91 | v. tetracanthura,.. .. | R. S. IX, 53, XIII, *8a-c*, | B. 3 | C. 3*b*. |
| | Ptychoparia, Corda. | | | |
| | P.—— Adamsi, Bill., .. .. | R. S. 2nd, III, 199, IV, 9, | N. | E. 3. |
| | var., .. .. .. .. .. .. | R. S. 2nd, III, 189, IV, 9, | B. 2 | C. 1*d*. |
| | narrow form, .. .. | R. S. 2nd, III, 182, III, *2a*, *b*, .. .. .. .. .... | B. 2 | " |
| 87 | P.—— alata, .. .. .. .. .... | R. S. V, 147, II, *2a-f*,.. | B. 3 | C. 1*d*. |

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| (99) | P.—— cordilleræ, Roeming. | R. S. 2nd, V, 44, I, 7, | W. | C. 3*b*. |
| 97 | P.—— limbata, | R. S. 2nd, III, 180, III, 1*a-d*, | B. 2 | C. 1*d*. |
| 87 | P.—— Linnarssoni, Brögg., | R. S. V, 143, II, 1*a-m*, | B. 3 | C. 1*d*. |
| | Solenopleura, Angelin. | | | |
| 85 | S.—— Acadica, Whiteav., | R. S. III, 56, VII, 15; V, 157, II, 5*a*, | B. 3 | " |
| 87 | v. elongata, | R. S. V, 159, II, 6, | B. 3 | " |
| | S.—— arenosa, Bill. sp., | R. S. 2nd, III, 182, IV, 10<br>R. S. 2nd, III, 199, IV, 9, | N. | E. 3. |
| 97 | v. angilimbata, | R. S. 2nd, III, 183, III, 3*a, b*, | B. 2 | C. 1*d*. |
| 86 | S.—— bombifrons, | R. S. IV, 156, *f*. 5, 5*a, b*, | E. 3 | E. 3. |
| 03 | S.—— Bretonensis, | S. R. 176, XI, 5*a-c*, | D. 1 | E. 2(*a*?). |
| 86 | S.—— communis, Bill., | R. S. IV, 155, *f*. 4, 4*a, b*, | E. 3 | C. 1*d*. |
| 87 | S.—— Robbii, Hartt sp., | R. S. V, 153, II, 3*a, b*, and 4*a-e*, | B. 3 | C. 1*c*2. |
| | v. Orestes, | R. S. V, 154, II, 4*a-e*, | B. 3 | " |
| 95 | m. parva, | R. S. 2nd, III, 183, III, 4*a, b*, | B. 2 | C. 1*d*. |
| 99 | Sphærophthalmus, Angelin. | | | |
| (03) | S.—— alatus, Boeck, | S. R. 228, | B. 3 | C. 2 C. 3*b*. |
| 00 | S.—— Fletcheri, | N. B. IV, 280, V, 7*a-f*. | D. 1 | " |
| 99 | Strenuella, s. gen., | R. S. 2nd, V, 75. | | |
| | S.—— attleborenis, S. & F. | | | |
| 99 | m. vigilans, | R.S. 2nd, V, 78, IV, 4*a-c* | E. 3 | E. 3. |
| | S.—— strenua, Bill. sp., | R. S. 2nd, V, 76, | E. 3 | " |
| 99 | m. robusta, | R. S. 2nd, V, 76, IV, 3, | E. 3 | " |
| | Triarthrus, Green. | | | |
| 02 | T.—— Belli, | N. B. IV, 412, XVIII, 8, | D. 1 | C. 3*c*2. |
| | Zacanthoides, Walcott, | | | |
| (99) | Z.—— spinosa, Walc, | R. S. 2nd, V, 57, | W. | C. 3*b*. |
| | CIRRIPEDA. | | | |
| (96) | Plumulites, Barrande, note, | N. Y. XV, 199. | | |
| 96 | P.—— Manuelensis, | N. Y. XIV, 200, XIV, 7, | B. 3 | C. 1*d*2. |
| 96 | Cirripodites, gen., | N. Y. XIV, 205. | | |
| 96 | C.——, types A to G, | N. Y. XIV, 206, XIV, *a-n*, | B. 3 | C. 1*c*. |
| 03 | Eurypterid Crustacean, | S. R. 177, XI, 3, | D. 1 | E. 2(*a*?) |
| | TRAILS, TRACKS AND BURROWS. | | | |
| | Arenicolites, Salter. | | | |
| (99) | A.—— antiquatus, Bill, | R. S. 2nd, V, 7, 1, IV, 1*a, b*, | E. 3 | C. 2*b*. |
| 90 | A.——brevis, | R. S. VIII, 159, XI, 13*a-c* | B. 3 | C. 2*c*. |
| | | R. S. 2nd, V, 72, | D. 3 | C. 2*b*. |
| 89 | A.—— Lyelli, Torrel, v. minor, | R. S. VII, 159, IX, 2*a-c*, | B. 3 | E. 2. |

| Year | Generic and Specific Name | Place of Publication | Locality | Horizon |
|---|---|---|---|---|
| 90 | Ctenichnites, n. gen., .. .. | R. S. VIII, 151. | | |
| 03 | C.—— bisulcatus, .. .. .. | S. R. 239, .. .. .. .. .. | D. 1 | C. *2a.* |
| 90 | C.—— ingens, .. .. .. .. | R. S. VIII, 151, XIV, 1-12, .. .. .. .. .. .. | B. 3 | C. *2c.* |
| | | R. S. 2nd, V, 72, .. .. | B. 3 | C. *2b.* |
| | Eoichnites, gen., .. .. .. .... | | | |
| 90 | E.—— Linnæanus, Torrell,. | R. S. VIII, 148, XIII, 2-6, .. .. .. .. .. .. .. | B. 3 | C. *2c.* |
| 90 | Fræna Rauault, ramosa, .. | R. S. VIII, 157, XI, 11, | B. 3 | C. *2c.* |
| 90 | F.—— Goniadichnites gen., trichiformis, .. .. | S. R. VIII, 160, XI, 12, | B. 1 | C. *2a.* |
| 90 | Medusichnites (and Taonichnites), .. | R. S. VIII, 143. XII, 1-3, *4a-d;* XIII, 1, .. | B. 1 | C. *2a.* |
| | Monocraterion, Torrell (69) | | | |
| 90 | magnificum, .. .. .. .. .. | R. S. VIII, 161, XVI, 1, *1a, b,* .. .. .. .. .... | B. 3 | C. *2c.* |
| 89 | Psammichnites, Torrell, | | | |
| | P.—— gigas, .. .. .. .. .... | R. S. VII, 157, IX, *1a-k;* VIII, 157, .. .... | B. 3 | E. 2. |
| 85 | Eocoryne, gen. .. .. .. .. | R. S. III, 31. V. *4a, b,* | | |
| | E.—— geminum, .. .. .. | VIII, 130, XI, *1a-c*,.. | B. 3 | C. 1*c*2. |
| | Lepiditta, gen., .. .. .. .. | | | |
| 85 | L.—— anomala, .. .. .... | R. S. III, 62, VI, 18, *18a;* VIII, 130, XI, 2, .... | B. 3 | C. 1*c*2. |

# SUMMARY.

| | Genera | Sub-genera | Species | Mutations | Varieties |
|---|---|---|---|---|---|
| Algæ, .. .. .. .. .. .. .. .. .. .. | 6 | | 5+1= 6 | | |
| Protozoa, .. .. .. .. .. .. .. | 4 | | 12 | | |
| Spongida, .. .. .. .. .. .. .. | 6 | | 8+1= 9 | | 1 |
| Hydrozoa, .. .. .. .. .. .. .. | 10 | | 18+1=19 | | 3 |
| Echinodermata, .. .. .. .. .. | 3 | | 3 | | |
| Brachiopoda, .. .. .. .. .. .. | 24 | 4 | 84+7=91 | 15 | 13 |
| Lamellibranchiata, .. .. .. .. | 1 | | 2 | | |
| Petropoda, .. .. .. .. .. .. .. | 2 | | 3 | | |
| Gasteropoda. .. .. .. .. .. .. | 8 | | 15 | | |
| Cephalopoda, .. .. .. .. .. .. | 1 | | 2 | | |
| Annelida, .. .. .. .. .. .. .. | 7 | | 34+2=36 | 2 | 1 |
| Ostracoda, .. .. .. .. .. .. .. | 11 | | 39 | 11 | 1 |
| Phyllopoda, .. .. .. .. .. .. | 3 | | 9 | 1 | 1 |
| Trilobita, .. .. .. .. .. .. .. | 35 | 9 | 120+2=122 | 12 | 47 |
| Tracks, Trails and Burrows, | 9 | | 12 | | 1 |
| | 130 | 13 | 380 | 41 | 68 |

The preceding summary gives a "bird's-eye view" of the relation in numbers of the several classes and orders of Cambrian animals and plants found in the eastern provinces of Canada, and serves to emphasize the prevalence of certain types and the absence of all the higher orders as well as some of the lower ones that are common at the present day. No vertebrates and none of the higher crustacea appear. True corals and the Bryozoa are absent.

The Echinoderms are represented by a few Cystids. The extreme weakness in number of the Lamellibranchs or Pelycepods is notable, for though regarded as one of the lower classes of Molluscs, they do not show as much strength as some of the higher.

The removal of Hyolithidæ (which are to be regarded as Benthos rather than Plankton), greatly weakens the Pteropoda; there remains in this division only two genera of small species of pelagic habit which are thought to have relations with this group rather than with the worms.

The Gasteropoda show a number of varied and ancient types, but the Cephalopoda would not appear in this list if there were not an Ordovician fauna in the uppermost part of the St. John terrane which otherwise is Cambrian.

The large number of species included in the Annelida is due to the fact that we have included here the Hyolithidæ which by the great Barrande and many subsequent writers were included in the Pteropoda. The arguments for this have been shown in some of the papers referred to in this catalogue and need not be repeated here. It will probably be found that Orthotheca should be included in Volborthella; the writer cannot distinguish the latter from a small decollated Orthotheca. A study of the question by some Russian author with larger material in hand is desirable.

It will easily be seen that Brachiopoda and Trilobita are the dominating types of Cambrian animals.

# OBSERVATIONS OF PLANTS, 1902.

BY G. U. HAY.

The winter of 1902 was remarkably open. Snow and sleighing disappeared the last week in February. A snow storm at the end of the first week in March renewed the sleighing, but only for a few days. Weather cold during March, but there were many bright, warm days, followed by cold rains in late March and early April. The St. John river was clear of ice on the 27th of March, the earliest on record. Tussilago farfara (coltsfoot) in bloom in the open places in St. John, April 8; in St. Stephen, April 7. (J. V.)

## WILD GARDEN AT INGLESIDE (12 miles from St. John).

*April* 5.—Frost out of the ground in the clearings. A few mayflowers in bloom on the barrens near by. Alder catkins descharging pollen when shaken. Willow and poplar catkins out.

*April* 19.—Not much advance in vegetation the past fortnight. Fine days, followed by hard frost at night, keeping the ground frozen. Flower buds of red maple becoming red and showing signs of bursting. The catkins of populus tremuloides shedding pollen. Mayflowers in full bloom on the barrens; but just opening in the Garden.

*April* 25.—White violets and wild strawberries beginning to bloom. Dirca palustris in bloom. Dog-tooth violet showing leaves above ground, and leaf buds swelling on deciduous trees. Red maples in full bloom. Mayflowers in Garden in full bloom.

*May* 1 -5.—Last three days of April fine and tolerably warm, followed by cold winds in early May. Nights continue cold with frost, and but little rain. White violets in full bloom, and a few blue violets appearing. Painted trillium beginning to bloom. Wind anemone in leaf and bud. Blood-root, dog-tooth violet, and hepatica in bloom. The red maple trees a mass of bloom. Mountain fly-honeysuckle in leaf and flower.

*May* 16.—Weather very cold from May 11 to 19. Frost

nearly every night, sometimes severe enough to freeze the ground and form ice in shallow pools. Cold north winds every day and no rain. Caltha palustris, dandelion, wind anemone in bloom; uvularia, amelanchier, bluets, gold thread in sunny places beginning to bloom. Viburnum lantanoides expanding its floral involucre. Red cherry trees putting forth leaves and flower buds. The osmunda ferns unfolding their fronds, and the woodsias on rockeries fully expanded. The long catkins of the mountain alder pendulous and discharging pollen. The spring flowers of nearly every species are few in number, shrivelled in appearance, and lacking size and freshness. The weary waiting for genial skies and grateful showers and the prevalence of March winds in May have retarded vegetation. An exception is the red maple, which still continues to bloom, its masses of crimson flowers forming a beautiful contrast to the delicate green of myriads of unfolding leaves. The pure white blossoms of the amelanchier mingling with the soft purple-brown of the fresh-opening leaves, followed a week later by the bloom of the red cherry, makes up a picture that is unequalled in beauty in our northern woodlands.

*May* 22.—In bloom: viola pubescens, caltha palustris, trientalis americana,trillium grandiflorum (not native), trillium erectum, trillium cernuum (in bud), veronica serpyillifolia, claytonia, virginica, sambucus pubens. Rock maple, poplar, white and red maples, birches, rowan tree. all in leaf, except betula populifolia.

*June* 24.—A bright, pleasant day, but with cool breeze. The weather which has been cold, with chilly winds, is now warm and summerlike. Lilacs, rowan tree and honeysuckle coming into bloom, and ampelopsis and acacia bursting into leaf. Stemless lady's slipper and pinguicula in bloom (June 4).

*October* 31.—A wet season, with mushrooms and toadstools in every color in greatest profusion, especially in the evergreen woods. About 150 species collected and named. Material all too abundant during the season, which lasted until the frosts of early November. The weather in September and October was more changeable than usual, and toward the last of the latter month strong gales prevailed. Light frosts occurred in late September and early October. The night of October 9 was very cold, with frost sufficient to make ice, with a snow storm early the

following day. Some severe weather with northwest gales between the 20th and last of month, alternating with milder weather, southwest winds and rain. The deciduous trees have not shown this season their usual variety and beauty of coloring in their foliage, and there has been apparently no Indian summer up to date (October 31).

## Observations of Plants in Wild Garden, Ingleside, 1903.

*May* 9.—The weather dry and variable, with cold nights. The spring opened early, as in the previous season, but cold winds, absence of rain and occasional frosts have retarded vegetation. White violets and dog-tooth violet in full bloom, with a few of the following: Dandelion, viburnum lantanoides, blue violets, lonicera ciliata, strawberry. Going out of bloom: Mayflowers (in Garden), dirca palustris, red maple.

*May* 16.—Weather cold, with northwest winds for the past few days. Heavy frosts at night and ice forming in places. In bloom: Painted and purple trilliums, gold thread, bluets, viburnum lantanoides, wind flower, caltha palustris, uvularia; amelanchier and white trillium unfolding. White birch, red maple, amelanchier, trembling poplar, horse chestnut, black cherry, red cherry, lilac just coming into leaf.

*May* 25.—Cold, with northwest winds for the past three days. Weather bright and sunny. Rain needed. Red oak, elm and populus grandidentata just coming into leaf. In flower: trillium cernuum, dewberry, rhodora, blueberry, actæa alba, bog bean, cornus canadensis.

*May* 31.—Plants in bloom: Trientalis americana, clintonia borealis, nemopanthes canadensis, viola pubescens, cypripedium acaule, red cherry.

*June* 8.—Frost first few nights in June, but not heavy enough to do damage. No rain, except a few scattered showers since April 29. Everything very dry, and forest fires raging for the past fortnight doing much damage to the timber lands, and destroying buildings in the Inglewood, Musquash and other districts west of the St. John river. Nothing growing in the parched and smoke-laden atmosphere.

*June* 15.—The copious showers of the past week are quenching forest fires and bringing relief to fire-threatened districts. Belated plants have sprung from the ground as if by magic, the foliage has freshened, and the grass promises an abundant crop. East winds prevail, and there has been no warm weather yet, except an occasional day.

*June* 30.—Rains and fine weather prevailed alternately during the last half of June. Cold at times. Little warm weather yet, but a fine growing time.

# APPENDIX.

## FORTY-SECOND ANNUAL REPORT

OF THE

## COUNCIL OF THE NATURAL HISTORY SOCIETY

OF

## NEW BRUNSWICK.

The Council of the Natural History Society of New Brunswick submits the following report for the year ending December 31st.

### MEMBERSHIP.

During the year the membership has been increased by the admission of five ordinary and fourteen associate members, one corresponding and one junior member. Three ordinary members have died, one has removed from the city—Mr. Geoffrey Stead, who has been elected a corresponding member. The names of the deceased members are: Franklin Stetson, John MacKinnon, E. G. Scovil.

The following shows the numbers, classes and total enrolled membership:

| | |
|---|---|
| Honorary, | 4 |
| Life, | 5 |
| Corresponding, | 24 |
| Ordinary, | 54 |
| Associate, | 84 |
| Junior, | 2 |
| Total, | 173 |

## TREASURER'S REPORT.

*Income—*

| | | |
|---|---|---|
| Balance from 1901-2, | $441 18 | |
| Interest on investments, | 56 25 | |
| Bulletins sold, | 10 63 | |
| Government grant, | 200 00 | |
| Membership fees, | 215 00 | |
| Fredericton N. H. S. for publishing report, | 27 50 | |
| Dividend Botsford estate, | 10 00 | |
| Donation to improve the Botanical Collection by adding specimens of native woods, preserving the plants from the ravages of insects and otherwise adding to its usefulness and educational value, | 40 00 | |
| | | $1,000 56 |

*Expenditure—*

| | | |
|---|---|---|
| Maintenance of Museum, | $ 33 56 | |
| Library, books and binding, | 41 25 | |
| Printing and distributing Bulletin XXI, | 204 37 | |
| Sundries, | 143 74 | |
| Balance, | 577 64 | |
| | | $1,000 56 |

Of the above balance $33.00 is held in trust for the Ladies' Association.

The Society owns besides a $1,500.00 mortgage, $1,000.00 special deposit Bank of Nova Scotia; ($11.84) $11.86 special deposit Bank of Montreal (Building Fund).

Special attention is directed to the Building Fund, as it will be noticed that the $10.00 donated in December, 1897, has not been increased by any additions except the interest which it has earned.

The mortgage is protected by insurance.

The collections in the Museum are protected by an insurance of $2,500.

A. GORDON LEAVITT,
*Treasurer.*

January 19th, 1904.

## LIBRARY.

A rough list has been made by the assistant curator of the books and pamphlets in the library, preparatory to a re-cataloguing and re-arrangement, so that the library may be made more useful to the members. This book the librarian and library committee hope to have completed during the present year, and the Council has appropriated a sum not exceeding fifty dollars for the purpose of defraying the expenses.

## PUBLICATIONS.

Bulletin XXI has been published during the year, containing 152 pages, comprising many useful articles, illustrating the progress of scientific work and discovery in New Brunswick. Other papers of more popular interest have been published in the local papers.

## LECTURES.

Ten regular meetings, including the annual meeting, were held, and two special meetings. The following are the dates of the meetings and the titles of papers read:

1903.

Jan. 6 (a) On the reported appearance of the Panther (Felis concolor) in New Brunswick, by Prof. W. F. Ganong.
(b) The Parasite, by Geo. G. Melvin, M. D.
(c) Some Rare Plants and their Habits, by H. F. Perkins, Ph.B.

Jan. 20. Annual Meeting. President's Address. Election of Officers.

Feb. 3. (a) Notes on the Natural History and Physiography of N. B., by Prof. W. F. Ganong.
(b) Notes on New Brunswick Fishes, by Chas. F. B. Rowe.

Mar. 3. (a) The Forestry situation in New Brunswick, by Prof. W. F. Ganong.
(b) Notes on the Violets; "Wintering;" by J. Vroom.

April 7. (a) The structure of the Common House Fly, by W. H. Mowatt.
(b) Some remarkable Tree Forms in New Brunswick, by W. F. Ganong.

May 5. (a) Birds and their Structure, by A. Gordon Leavitt.
(b) Birds and their Nests, by J. W. Banks.

June 2. Report of the Royal Society Meeting at Ottawa, by Dr. G. F. Matthew.

Oct. 6. (a) Notes on New Brunswick Mushrooms, by G. U. Hay, D. Sc.
(b) The Highest Land in New Brunswick, by W. F. Ganong, Ph. D.

Nov. 3. (1) Fossil Foot Prints; (2) Genus Hylopus—Dawson; by G. F. Matthew, D. Sc.
Two papers on the Physiography and Natural History of New Brunswick (read by title), W. F. Ganong.

Dec. 1. Caverns, Caves and Cavities, by Professor L. W. Bailey, Ph. D.
Papers by Dr. Ganong (read by title).

December 30 a special meeting was called, which was addressed by Mr. M. L. Fernald on the distribution of certain plants on the Gulf of St. Lawrence shores.

A special meeting was also held on the evening of February 10th to hear the address of Hon. H. A. McKeown on "The Border Land between Insanity and Crime."

An elementary course of lectures was given on the Tuesday evenings not occupied by the regular meetings during the months of January, February, and a part of March. The following programme was carried out: Dr. G. F. Matthew gave two lectures: January 13, "Volcanoes. their Origin and Effects." January 27, "Water as an agent in modifying the Earth's Surface."

Dr. G. U. Hay gave two lectures on Ferns, their mode of growth, reproduction, habits and uses—February 17 and 24.

Mr. A. Gordon Leavitt gave one of the course of elementary lectures, on Bird Structure, and another was given on Exotic Ferns by Mr. Wm. McIntosh.

## Ladies' Association.

The following course of lectures, carried out on Thursday afternoons during the winter by the Ladies' Association, was in marked agreement with the objects of our Society:

Jan. 15. Thoreau. Mrs. E. S. Fiske.
22. Reminiscences of the American Museum. Mrs. G. F. Matthew.
29. Children's Day—
A Talk on Insects. Mr. Wm. McIntosh.
Feb. 5. Wordsworth: A Nature Poet. Mrs. G. A. Hamilton.
12. Color in Nature. Miss A. Jack.
19. A Pre-historic Mound in Ontario. Miss A. L. Hunt.
26. Children's Day—
A Talk on Birds. Mr. A. Gordon Leavitt.
Mar 5. The Scientific Basis of Art. (Illustrated). Miss M. Barry Smith.
12. A Ramble in Switzerland. Miss Christine Matthew.
19. Nature Study in the Public Schools. Miss G. Murphy.
26. Reunion of Members.

There are eighty-four names on our associate membership roll, a slight increase over the previous year. The organization continues to be a very active one, and the ladies have shown themselves at all times desirous to assist heartily in the work and

objects of our Society. Unfortunately our rooms, difficult of access and cramped in space, do not afford the opportunity of carrying out some work that we might attempt in the way of a better arrangement and display of our archæological, botanical and other natural history specimens, and fitting up a more attractive library room.

## Library and Museum.

The library and museum have been open to visitors three afternoons of each week—Tuesday, Thursday and Saturday. The assistant curator, Miss Florence A. Hoyt, has attended very promptly and faithfully to her duties.

The number of visitors during the year has been seventy-eight adults and 357 children.

Additions have been made to the collections in the museum during the year, the most valuable being that of specimens of insects, representing the beetles, by Mr. Wm. McIntosh.

Changes are now being made in two of the principal rooms of the museum,—adding to the cases, cleaning the walls, renovating the specimens and displaying them to greater advantage. These changes will be greatly appreciated by members and visitors.

## Archaeology.

During the year this subject of archaeology has received attention from Dr. A. C. Smith, of Tracadie. He has for many years been an energetic member of our Society, and has made a number of valuable contributions to our museum. He has carried on researches in the vicinity of Tracadie which have shed much light on the life and early history of that part of the province.

At our January meeting he presented, through Dr. Matthew, a note on ancient modes of sepulture observed by him in an old graveyard near Tracadie. Accompanying his note were several illustrative specimens. He has received our hearty thanks for the excellent work he has done.

S. W. Kain has published two short papers during the year:

(1) An Old Religious Medal, *Acadiensis*, Vol. III, pp. 96-97, 1903.

(2) Trade Pipes, *Acadiensis*, Vol. III, pp. 255-258, 1903.

## Geology.

The following note on a new locality for post-pleioscene shells may be taken as the report of the geological committee for the past year:

In December last Mr. J. P. Clayton, the superintendent of Fernhill cemetery, brought to this Society a lump of clay which he had dug up in making a catch-basin for one of the drains in the cemetery grounds.

In digging for this basin he stated that he had first passed through about a foot and a half of gravel and sand, then through six feet of red clay, and finally had struck the layer of black clay or mud of which the sample consisted.

The notable feature about this black clay is that it abounds in shells of the common mussel. These shells are in an excellent state of preservation; some of them with valves applied to each other as in life, and all having the color and nacre of the shell perfectly preserved.

In the same bed, but at a somewhat higher level, were a few sea-urchins, which must have been recently living or dead when they were entombed, as the plates of the skeleton were applied to each other, and the spines were in juxtaposition to the bosses on the plates to which they had been attached.

A few colonies of bryozoans also were observed and plates that may have belonged to barnacles.

Remains of strap-like and confervoid seaweeds are abundant in the upper layers of the bed, the black color of which seems largely due to the decomposed organic matter of these seaweeds and the animal fossils.

It is evident that the bed of shell-bearing clay, which is a few inches thick, was deposited in water of some depth, as the remains are in such perfect condition and show no evidence of having been subjected to the wash of the waves, nor does the deposit contain any strictly littoral shells.

It is interesting to compare the height of this bed above the present sea level with those of other localities where sea-shells have been found. A well known level of this kind, where the

remains of shell fish were found, was at the east end of Lawlor's Lake, where, at the level of about sixty feet above the sea, there is a bed of clay and sea-sand containing shells of the common clam, the sea-urchin, the rock barnacle, and other species.

Another place where marine shells have been found is at the gravel bank north of the dam of the reservoir of the city water works on Little River, where the late Gilbert Murdock, Esq., found clam shells *in situ*. This place is about 160 feet above high tide mark.

Mr. William Murdock, the superintendent of the city water supply, informs me that the locality, where the clay bed with shells found by Mr. Clayton is situated, is ninety-five feet above high tide mark. The Leda clay (brick clay) has been found as high as 200 feet above the present sea level in this district; so this mussel bed must have been some scores of feet below the sea level when the Leda clay sea was at its greatest depth over the district around St. John.

## ENTOMOLOGY.

The most important work in this department is the preparation of a list of the lepidoptera.

## BOTANY.

Late in December Mr. M. L. Fernald, of the Gray Herbarium, Cambridge, Mass., paid a visit to St. John, and spent some time in examining the plants of our collection. He found here several rare species of flowering plants, the discovery of which adds to the knowledge of the distribution of our plants.

An examination of the plants in our herbarium reveals the presence of insects which must be removed if we hope to save the collection. This should be done at once, as the plants, representing our field work for nearly forty years past, are of great value from a historical and from other points of view to the students of our flora.

We need more space than our rooms afford to make a display of plants for educational purposes and to illustrate their economic uses. We need especially at the present time a collection of the native woods of the province and facilities in our museum to

show them to advantage. Our plants at present are only useful for reference. Little opportunity is given to the student for examination and study, especially of the shrubs and trees, the most important section of our flora.

The botanical committee is keeping in view the early publication of a revised up-to-date list of the plants of the province.

Professor W. F. Ganong made an important study of the salt marshes under the title of "The Vegetation of the Bay of Fundy Salt and Diked Marshes: an Ecological Study." It was published in the Botanical Gazette, Vol. XXXVI, pp. 161-186, 280-302, 349-367, 429-445. September to December, 1903.

Additions have been made to the list of fungi published in last year's Bulletin. These additions representing some rare species of our larger fungi will be published in the next Bulletin.

## Field Work.

The field work of the Society, as a whole, was confined to a series of Saturday excursions in the month of June. These were conducted by different members of the Society for the purpose of studying the geology, plants and animals of the park and other places near the city. An effort should be made to carry out these field meetings in future seasons on a more extensive scale, and especially to get as large a number of young people as possible interested in nature-study. If these become interested in summer, they will be desirous of crowding into our lecture-room and museum in the winter months.

If our members could devote a little more time and enthusiasm to field meetings, and to the holding of a summer camp, which has been a great source of interest and advantage to us in years past, it would be a great benefit to the Society.

## General.

The grateful acknowledgments of the Society are tendered to those gentlemen who have prepared papers for the meetings and for publication in the Bulletin, especially to Professor W. F. Ganong, who has done so much in his papers on physiography and natural history to make us acquainted with the wild and

little-known regions of the interior of the province. Our thanks are also due to the press for the free publication of notices and reports.

In planning the elementary course of lectures for the current year, the committee has sought to make them available for pupils in the higher grades of the schools; and there is evidence that many will avail themselves of the advantages of these lectures.

In the proposed Ter-centenary of the discovery of St. John by de Monts and Champlain, our Society has felt from the first that it would be desirable to have the Royal Society meet in St. John on the occasion. Accordingly an invitation from this Society, and from the Historical and Loyalist societies, was extended to the Royal Society at its meeting in Ottawa in May last to meet in St. John about the 24th of June, 1904. The invitation was favorably considered, but action was left to the Council, which meets in Ottawa early in February. It is the feeling among members of this Society, that should the Royal Society accept the invitations and honor the city by its presence, this Society will do everything possible to make the meeting a pleasant one.

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## DONATIONS TO THE MUSEUM, 1903.

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|---|---|
| Feb. | Dr. Geo. A. Hetherington. Garter snake.<br>Stanley Thompson. Plumbago and can.—Sinter. |
| March | Inglis C. Craig, M.A. Specimens of copper ore. |
| May | Dr. G. F. Matthew. Two specimens of serpentine rock.<br>Miss B. Bowman. Specimens of Continental money. |
| June | Master Lynch. Piece of root with stone embedded.<br>Dr. G. U. Hay. Specimens of fungi.<br>Miss G. Ross. New Testament in different languages. |
| Oct. | Mrs. Hendershot. Specimens of minerals and rocks from Yellowstone National Park. |
| Nov. | S. W. Kain. Collection of pipes.<br>Wm. McIntosh. Three cases of beetles.<br>Dr. G. F. Matthew. Cast of largest footmarks found in Canada. |
| Dec. | Duncan London. Stone knife and ornaments (Indian.<br>Dr. A. C. Smith. Iron knife, scrapers, ochre fish hook, harpoons, etc., dug from Indian grave at Tracadie, N. B.; also a "flint and steel." |

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## ST. JOHN OBSERVATORY.

### METEOROLOGICAL ABSTRACT FOR 1903.

Latitude 45.17 N. Longitude 66.4 W.

| MONTH. | BAROMETER | | | THERMOMETER | | | *Cloudiness:* 0 = Clear 10 = Wholly Clouded | *Precipitation:* Rain & Melted Snow | Thunder Storms | Fogs |
|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | Highest | Lowest | Mean | Max. | Min. | | | | |
| Jauuary,... | 29.82 | 30.69 | 29.04 | 21.8 | 47.0 | —12.5 | 6 | 3.49 | 0 | 3 |
| February,.. | 29.87 | 30.45 | 28.86 | 22.6 | 49.3 | — 4.7 | 5 | 3.57 | 0 | 1 |
| March,..... | 30.23 | 30.78 | 29.33 | 34.8 | 49.8 | 4.0 | 3 | 7.37 | 0 | 2 |
| April,.. . | 29.89 | 30.43 | 29.34 | 40.4 | 72.3 | 16.8 | 6 | 5.76 | 0 | 3 |
| May, .. .. | 30.14 | 30.56 | 29.64 | 48.9 | 72. | 28.3 | 4 | 3.13 | 0 | 4 |
| June,...... | 30.03 | 30.44 | 29.72 | 57.3 | 75. | 41.8 | 7 | 3.12 | 2 | 6 |
| July, ..... | 29.84 | 30.12 | 29.38 | 60.9 | 80. | 48.2 | 7 | 2.31 | 5 | 14 |
| August,.... | 30.00 | 30.37 | 29.39 | 60.3 | 74.2 | 48. | 5 | 1.55 | 2 | 4 |
| September,. | 30.07 | 30.59 | 29.67 | 58.2 | 82.5 | 39. | 4 | 2.17 | 2 | 8 |
| October, ... | 30.01 | 30.45 | 29.20 | 47.3 | 63. | 27.5 | 6 | 4.06 | 1 | 3 |
| November,. | 29.92 | 30.74 | 29.34 | 36.7 | 61.8 | 12. | 5 | 4.67 | 0 | 1 |
| December,.. | 29.89 | 30.45 | 29.13 | 22. | 51.5 | — 5.5 | 5 | 3.99 | 0 | 0 |

The mean height of the barometer was 29.98. The highest reading was 30.78, and the lowest 28.86. The mean temperature for the year was 42.6, being 0.7 warmer than the average. Maximum temperature 82.5 on September 14; minimum—12.5 on January 19. The total precipitation was 46.95 inches, which is +0.13 different from average.

First frost occurred on the 22nd of October, and the last on the 14th of May.

Aurora was observed on the 5th of April, 21st of August, 31st of October and 13th of December. A meteor of exceptional brilliancy was observed at 8.15 o'clock (60th Meridian time) on the night of the 13th November. For a second or more the city was as brightly lighted as at mid-day. The meteor moved from east to west, followed by a trait of light visible for several seconds.

D. LEAVITT HUTCHINSON,
Director, St. John Observatoty.

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# BULLETIN

OF THE

# NATURAL HISTORY SOCIETY

OF

## NEW BRUNSWICK.

No. XXIII.

VOLUME V. PART III.

NATURAL HISTORY SOCIETY OF NEW BRUNSWICK · ST. JOHN, N.B.

PUBLISHED BY THE SOCIETY.

SAINT JOHN, N. B.:
BARNES & CO., PRINTERS, PRINCE WILLIAM STREET.
1905.

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# BULLETIN

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## ARTICLE I.

# NOTES ON THE NATURAL HISTORY AND PHYSIOGRAPHY OF NEW BRUNSWICK.

By W. F. Ganong.

### 81.—New Brunswick Animals and the Animal Romancers.

**Read by title December 1, 1903, and in full March 1, 1904; re-written Jan., 1905.**

The last quarter of a century has seen a remarkable development in that form of literature which consist of charming popular writings about animals and their doings. A leader of this movement in America was John Burroughs, whose work combines literary grace with scientific truth to a degree not surpassed by that of any other modern nature-writer, and there are several others of similar spirit. Recently, however, there have arisen somewhat suddenly into prominence three writers on nature subjects whose works enjoy a popularity far surpassing that gained by any of their predecessors or contemporaries. These three are Mr. Thompson Seton (earlier known as Seton Thompson), Mr. W. J. Long and Mr. C. G. D. Roberts. Of the former, I know little, but since the two latter have written extensively of New Brunswick animals I have been much interested in their works, and I propose to make some comments upon them from the point of view of New Brunswick natural history.

In examining the books by these graceful writers, two questions naturally arise: first, as to the cause of their surpassing popularity, and second, as to their worth as natural history. The cause of their popularity is, I believe, easily evident. It does not lie primarily in their literary charm, for in this they do not so far surpass other nature books, but it consists in this, that it tells about animals not as they are, but as people like to think they are. Ample evidence of this is found in the fact that the warm praise awarded these books for their fidelity to nature, their accuracy

of observation, etc., comes from reviewers and others who have themselves no real knowledge of the matters concerned, while those who actually know the subject are either silent or very unfavorable in their comments. It is the humanization and idealization of animals, which, under the influence of the remarkable literary skill of these authors, has made their animal stories so popular. To accomplish this end, they have had to cut loose from the trammels of fact which hampered their predecessors, and have given their imaginations full play, thus producing fascinating works of fiction disguised as natural history. It is, however, this disguise which constitutes the ground of criticism against these works. We all agree that the use of animals as the heroes of romances, or of other imaginative writing, is perfectly legitimate; it is only when such works profess at the same time to be accurate in their natural history, thus misleading their readers and pretending to a character to which they have no honest claim, that they become open to scientific criticism.

Mr. Long has published five books on animals, containing many references to New Brunswick. He claims repeatedly that his works are records of accurate fact discovered by his own observation in the field, and there is no question that he has given much study to animals in their native haunts. The most characteristic feature of the books, especially of those later-written, is the remarkable number and marvellous character of the experiences the author claims to have had in his observations of animals, and such wonders grow steadily through the series. The aggregate of his reported observations, both as to quantity and character, is such that, if all he states is true, he must have seen more widely and deeply into animal life than all other students of animal habits taken together. There is, of course, nothing inherently impossible in this, but its probability is emphatically denied by his writings themselves, which seem to me to show that he has little idea of the nature of evidence or of logical proof, and that he possesses neither the temperament nor the training essential to a disinterested observer. I have no proof, with the single exception noted below, that any individual statement of Mr. Long's is untrue; but an experience in the New

Brunswick wilderness at least as great as Mr. Long's has given me such a knowledge of the difficulties of observing wild animals in their native haunts that I cannot believe that any one man has had all of the remarkable experiences reported by Mr. Long. Furthermore, the one case in which I happen to know personally the evidence on which Mr. Long bases a statement, does not allow me to entertain a high regard for his accuracy. In his book, " School of the Woods," he claims to have seen fish-hawks catch and wound fish which they then dropped back into the water in order to teach their young to dive for them. This statement is criticised by Mr. Burroughs in his article on " Real and Sham Natural History," in the *Atlantic Monthly* for March, 1903, and in his reply to this article in the *North American Review* for May, Mr. Long re-affirms it, and adds: " Mr. Mauran Furbish, who probably knows more of the New Brunswick wilderness than any other man, has told me since my book was written that he had seen the same thing." Thinking I knew the incident on which this statement was based, I wrote Mr. Furbish, who has been my companion in two journeys into the wilderness of New Brunswick, asking what statement he had made to Mr. Long; he replied that he had simply told Mr. Long of our finding one day a wounded gaspereau floating at the foot of a lake, and that Mr. Long " had furnished all the romance and the reason for their being there." This incident, I believe, gives the clue to the character of much of Mr. Long's work. He does not deliberately invent, but some trifling basis of fact happening to fit in with some theory developed by his sympathies is accepted by him as confirming his surmises, which he thereupon considers and publishes as proven. Mr. Long's books undoubtedly contain a great deal of valuable fact, but this is so mixed with matter that cannot possibly be accepted simply on Mr. Long's statement, that it makes his work practically valueless as natural history.

Mr. Roberts has thrown most, or all, of his writings upon animals into the story form. In his earlier works he made no claim to a first-hand knowledge of these animals, but a belief in such knowledge naturally became widely prevalent among his reviewers and others, and he took no steps to correct the impres-

sion. But in the prefatory note to his latest book, "The Watchers of the Trails," he uses language which must lead the reader to believe that he possesses a thorough personal knowledge of the animals, based upon long and careful study of them in their native haunts. Yet those who know Mr. Roberts are aware that the requirements of his literary work for several years past have not permitted him to make those journeys into wild New Brunswick essential to the study of its animal life, and that his few earlier trips had not this object in view, and were not of a character to permit it. The experiences of his boyhood in the wilderness about his home, to which he refers in his latest preface, must necessarily have been confined to the smaller and commoner forms found near the settlements, and could not have included the moose, caribou, bear, lynx, and other great animals about which he chiefly writes. His knowledge of these animals must have been gained mostly in the public libraries, museums, and menageries of New York City, and his interpretations of their psychology, upon which latterly he lays some stress, can have little basis other than in his own imagination. In his later works Mr. Roberts apparently makes every effort to follow the best authorities on his animals, thus making a great advance over his earlier writings, which paid scant attention to some of the elementary facts of natural history. It is, of course, perfectly proper to use the accumulated knowledge of others as a basis for one's one work, but it is honest to use it in a way to imply, and especially to claim, that it is one's own? If Mr. Roberts would but state in the preface to his books that his studies are, for the most part, not based upon personal observation of their subjects, but are as accurate as he can make them from other sources of information, he would not only be dealing fairly with his readers, but he would, in my opinion, greatly enhance, through the added grace of sincerity, the value of his really remarkable imaginative works.

To the unscientific reader it may seem of slight account whether a pleasing and powerful writer obtains his knowledge at first hand from experience, or takes it from reliable books on the subject. As a matter of fact, however, it makes a vast difference

in the permanent effect produced upon the reader. The compiler of knowledge can never possess that sense of proportion, that balance, that caution which enables the original student to give correct impressions of the objects and scenes he describes. Hence the work of the compiler is little trustworthy in comparison with that of the original student. The pictures which Mr. Roberts gives of the forest and its animal dwellers are extremely vivid and very pleasing, but they do not represent the woods and the animals of reality, and the reader ought not to be led to believe that they do.

So opposite are the standpoints from which the scientific and the literary man view animal life, and so entirely indifferent are they to one another's standards, that the two are not only nearly impossible to one person, but they are well nigh mutually exclusive. The charm of the study to the man of science is the triumph of demonstrating the truth. He makes this his sole standard, as it is his sole reward. Slowly, patiently, laboriously, indifferent to popular opinion as to popular applause, he makes his resistless advances, aiming to prove each step before a second is made. He naturally has little regard, therefore, for showy leaps from scanty fact to sensational generalization, and he has no respect at all for a pretence of scientific knowledge not based upon an honest foundation. The new nature writer seems to view nature chiefly in the light of a fresh supply of literary material, and he values her phenomena in proportion to their adaptability for interesting and clever treatment. To him the truth is not of first importance, and imagination is allowed to improve upon nature whenever she can thereby be made more available for literary uses. All this may be legitimate in literature, but it is not in science. It remains to be seen whether works thus insincere in their foundation can be given long life by literary charm alone.

NOTE.—A vigorous discussion of Mr. Long's work was inaugurated by Mr. John Burroughs in a severe criticism in the *Atlantic Monthly* for March, 1903, under the title "Real and Sham Natural History." Mr. Long's reply followed in the *North American Review* for May. His defence was also taken up by his publishers, Messrs. Ginn & Co., of Boston, in an illustrated pamphlet, containing numerous complimentary

reviews of Mr. Long's work, reviews mostly quite worthless in this connection, since they are usually by persons quite without real knowledge of whether the works are accurate or not. Several very severe criticisms of his work from the scientific standpoint, marred in some cases by impatient and even intemperate language, followed in *Science*,—by W. M. Wheeler, in the number for February 26 (1904), by F. M. Chapman, on March 4, by the present writer (this note in somewhat different form) on April 15, and by W. H. Davis on April 22. Mr. Long's reply, notable for its dialectical skill, is in the same journal for May 13. The present note, in somewhat different form, was published in the St. John *Globe* for March 5; Mr. Long replied to it in the number for March 19, and I answered briefly in the same paper for March 26.

## 82.—On Vegetable, or Burr, Balls from Little Kedron Lake.

Read May 3, 1904.

Two years ago Professor Bailey showed me at Fredericton a ball of vegetable matter, almost spherical and some four inches in diameter, which had been given him by Mr. P. H. Gillmor, of St. George, and which was said to have been found in Kedron Lake. Applying to Mr. Gillmor for further information, he referred me to Mr. Wellington Davis, of Brockway, York Co., who sent me a similar ball, with letters, which read in part as follows:

I am sending you the best ball I have. It is not a very good one. . . . . I cannot tell you very much about it. It is found in the north end of the Little Kedron Lake in a small cove. No wind can strike the cove but from the southeast. It is surrounded with fir and spruce which hang over the water. The bottom is a clear sand. The spills (*i. e.* leaves or needles) drop from the fir and spruce and lie at the bottom. Then the water washing them from side to side forms the ball. There is no heavy swell comes in there. These balls can be found in no other place in the Little Kedron Lake, nor in Big Kedron Lake. Sometimes we have found them from six to eight inches through. . . . . There is a small underground spring-book running into the lake, just where we find them.

A photograph of the ball here referred to is given herewith.* It is composed chiefly of the leaves of fir and spruce, but with some other vegetable matter, such as small twigs, etc., in addition, all interlocked together.

* For the use of the cut I am indebted to the editor of the *Educational Review*, in the August (1904) number of which journal this note first appeared.

BURR BALLS. That on the left is from Little Kedron Lake, that on the right is a small specimen from Flint, or Sandy, Pond, in Massachusetts. The upper ruler shows centimetres, and the lower shows inches. (About one-third the true size).

*Face page 304.*

It is a coincidence that I was asked by a correspondent a year or two earlier whether the mode of formation of somewhat similar balls which occur in Flint or Sandy Pond in Lincoln, Massachusetts, is known. The balls which occur there, as shown by the small specimen photographed beside the Kedron Lake ball, are of much finer texture than that from Kedron Lake, and they are apparently composed chiefly of the tangled stems and leaves of the Duckgrass (*Eriocaulon septangulare*), with perhaps also some other materials. They are homogenous in structure, without any apparent nucleus. They are described by Thoreau in his "Walden" (Chapter IX), who shows (and the observation is confirmed by two correspondents who have written me concerning them), that they are formed upon a sandy bottom much as described by Mr. Davis. From these two cases one would infer that such balls must be of frequent occurrence in shallow sandy lakes. Having, however, inquired of my botanical friends without learning of any other localities or of any published description of their mode of formation, I inserted in *Science* for April 8th a letter of inquiry, asking for information as to other localities, local names for them, published references to, or descriptions of them, materials of which they are composed, etc. In response, I have received but very scanty information, including only a single reference to another locality for them—a lake in Idaho.

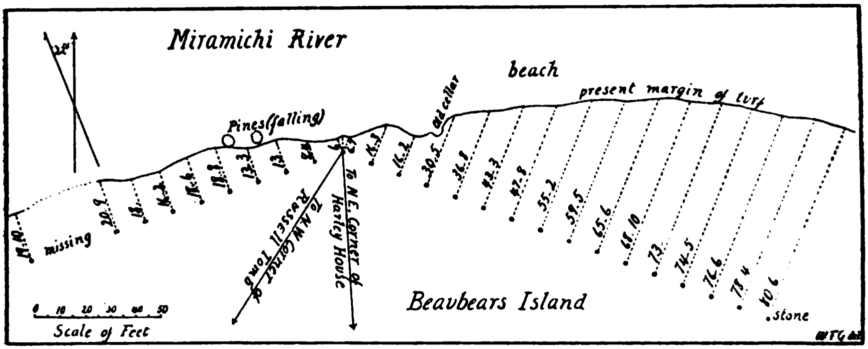
It would be remarkable if no description of these balls other than Thoreau's, nor any account of their mode of formation, has been published, yet such appears to be the case. Presumably they are nothing more than the result of the rolling about of vegetable fragments on hard sandy bottoms by the action of the under-water parts of waves. Probably, as one of my correspondents suggests, the material collects first in ripple-marks, there becoming somewhat matted together in short loose cylinders; as these enlarge they are rolled out and over the bottom, where, gathering other material, they gradually become larger, rounder, and more compact. It is not improbable that micro-organisms develop within them, and, by forming zooglœa or other glutinous matter, help to fasten them together. It would be worth while,

however, to trace out precisely how they start and under what conditions they may be formed. It happens that Dr. Hay and I were at Little Kedron Lake in July last (1904); had we known then of the existence of these balls there we might now possess some answer to these questions.

## 83.—A Measure of the Rate of Recession of the New Brunswick Coast Line.

Read November 1, 1904.

All available evidence appears to show that the coast of New Brunswick is slowly sinking beneath the sea, the anomalous case of Grande Plaine on Miscou Island being, as I shall later show, no real exception. The evidence on the subject is summarized in an earlier note (No. 43), where also a case permitting a rough measure of the rate of recession of the upland, accompanying this sinking, is described. This summer I noticed another and much better opportunity for such a measurement, which is as follows.




The lower or northern end of Beaubears Island at Miramichi is a cleared field (except for some scattered pines and spruces) a few feet above sea level, and it is obviously being rapidly eaten away by the sea. A little back from the margin of the turf there stood formerly a strong fence, the squared posts of which have been cut away close to the ground. As these posts are likely to remain untouched for the future, and as they are fairly sound, it

occurred to me that if offset lines at right angles to the line of posts were now measured and recorded, it would be possible by remeasuring those lines at any time in the future to determine the amount of recession of the land in the interval. Accordingly with the aid of a companion I measured such lines with a tape measure; and the results are plotted on the accompanying diagram. The lengths are expressed in feet and inches, and represent the distances from the edge of the wood of the posts (which are on the average somewhat under fourteen feet from centre to centre) to the present edge of the turf over the bank. Unfortunately the measurements are not exactly accurate, since I had not the means at hand to make the offset lines geometrically at right angles to the post lines, though they are as nearly so as they could be made by eye; and again it is difficult at times to determine just where the edge of the turf is. But nevertheless the figures are sufficiently accurate to enable us to obtain a fairly good idea of the rate of recession of this field when compared with similar measurements in the future. Of course the rate of recession is not a measure of the rate of vertical sinking, but the two are correlated, and the former is of much interest in itself. It is producing constant changes in the contour of our coasts, especially those of the North Shore, which are mostly low and but little above sea-level.

To the evidence of subsidence earlier mentioned (Note 43) may be added the case of groves of trees standing on sea beaches and now dying. An excellent example of this is found on Manawagonish Beach, near St. John, and another is at Point à Barreau, near Tracadie, in both of which instances the nearer approach of the sea, with its advancing beach, seems to be the cause of the death of the trees. It is possible that we have another illustration of the same thing on the beaches of the lower St. John, where large elms may sometimes be seen surrounded with beach gravel in situations where no saplings are to be found. Furthermore, we possess direct historical evidence pointing in the same direction. Thus, the maps made by Champlain in 1604 show the presence of upland and woody vegetation upon the bars at Advocate Harbor, and at Sand Point, St. John, in both of

which places at present the bars are only of bare sand submerged at the highest tides. Again, the map of the North Shore made by Jumeau in 1685, that by Franquelin-DeMeulles made in 1686, and that by an unknown surveyor made in 1754,* all show the presence of small islands lying off the eastern entrances of both Miscou and Shippegan Gullies, where now are nothing but shoals.

While the subsidence of the coast of the province is permitting the sea to invade and wash away the land, there are two places in which the sea is conspicuously building up the land, aside from the familiar cases of sandy points and bars. The one is at the Fundy marshes, where the tides are doing the work, and the other is at Grande Plaine on Miscou Island, where the sea is rapidly building extensive sand plains. At first sight the latter process seems to require an elevation rather than a sinking of the coast, but there is one fact which proves this not to be the case, namely, the inner and older beach lines are, as a rule, lower than the outer and newer. There are some exceptions to this, but these are cases complicated, I believe, by dune-drift phenomena. These great beaches are being built, apparently, by materials derived from the washing away of the coast in the vicinity, and brought here by the coastal currents. But the subject is one needing much closer study than it has yet received.

## 84.—New Aneroid Measurements in New Brunswick in 1904.

Read November 1, 1904.

In July and August last I spent several weeks on the headwaters of the Little Southwest Miramichi and Renous rivers, and made many measurements for altitudes with the results that follow. They were made with excellent aneroids, synchronously with the barometric readings of the government stations at Fredericton and Chatham (from which they have since been checked for weather corrections), and with the precautions and corrections for temperature, index error, etc., described in earlier notes:

* These maps are all given in my Cartography of New Brunswick in the Transactions of the Royal Society of Canada, Vol. III, 1897.

(Nos. 53, 62, 76). As before, I believe these measurements are as accurate as can be made with aneroids under New Brunswick conditions, and I do not think their error will be found to exceed a few feet.

In checking results from the Fredericton and Chatham stations I have found the same discrepancy as before between the two, amounting in this year's readings to an average of 32 feet, precisely the same that I found in 1902 (Note 62). As to its cause, I have nothing to add to the suggestions already made in Note 76. As to the practical question of allowance for it in my results, I have adopted the plan this year, since most of the places are roughly equidistant from the two stations, of giving equal value to the readings from the two stations. This I could the better do since, although I think the Chatham readings give results too low, I am inclined to think my instruments read, if anything, a trifle high.

The locations of the places mentioned in the following list may be found on the maps accompanying subsequent notes (Nos. 85, 86, 87). None of the places mentioned have ever been measured heretofore. The italic face type gives the elevation above mean sea-level.

*Gover Lake.* Mean of twenty-eight measurements, checked from Fredericton 1308 feet, from Chatham 1276 feet; hence *1292* feet above the sea.

*Dunn* (or *Logan*) *Lake.* Mean of five measurements, checked from Fredericton 1601 feet, from Chatham 1552; hence *1576* feet above the sea.

*Mitchell Lake.* Mean of seven measurements, checked from Fredericton 1381 feet, from Chatham 1352; hence *1366* feet above the sea.

*Crooked Deadwater.* Mean of seven measurements, checked from Fredericton 1367 feet, from Chatham 1333 feet; hence *1350* feet above the sea.

*County Line Mountain.* By direct measurement 695 feet above the Crooked Deadwater, and hence *2045* feet above the sea.

*Indian Lake.* One measurement checked from Fredericton gave 1607 feet, and from Chatham 1616 feet; hence 1611 feet above the sea. A direct measurement above Crooked Deadwater gave 263 feet above the latter, and hence 1613

feet above the sea, a remarkable agreement with the measurement checked from the stations; hence we may accept *1612* feet above the sea. This beautiful lake is therefore higher than Milnagek (Note 56), heretofore supposed to be the most elevated lake of any size in the province. But Indian Lake is also exceeded by the following.

*Moose* (or *Rocky Brook*) *Lake*. By direct measurement, 323 feet above the Crooked Deadwater, and about 60 feet above Indian Lake; hence *1673* feet above the sea. This height was so surprising, not only as worked out roughly on the ground, but as determined more exactly since, that I have inclined to keep all my figures conservative, and I am sure it is at least this height, and perhaps somewhat higher. This makes it the highest lake of any size yet measured, considerably exceeding Milnagek (Note 56), hitherto the highest known, as well as Indian Lake, also higher than the latter.

*Parker Lake*. By direct measurement 95 feet over Indian Lake, and hence *1707* feet above the sea, and the highest pond or lake yet measured in New Brunswick. It is hence higher than the preceding, but is merely a shallow pond, like so many others on the top of the central peneplain.

*Height of land between Parker and Indian Lakes* (on the hunter's trail). By direct measurement 165 feet over Indian Lake; hence *1777* feet above the sea.

*Height of land between Moose Lake and Indian Lake Stream*, (on the trail). By direct measurement 389 feet over Crooked Deadwater, and hence *1739* feet above the sea.

*Ridge South West of Crooked Deadwater*, (on the trail). By direct measurement, 189 feet over the latter; hence *1539* feet above the sea.

*Height of land on the Holmes-Renous Portage*, 150 feet over Holmes Lake; hence *1286* feet above the sea.

*Renous Lake*. Mean of six measurements, checked from Fredericton 1183 feet, and from Chatham 1170 feet; hence *1176* feet above the sea. My attempts to make direct measurements between this and Holmes Lake (the latter of which I made 1136 feet in 1901, Note 55), were foiled by the very changeable weather, but they seemed to show no great difference between the two, with Renous somewhat the higher. Hence we may accept the figure above given.

*Pond at the old driving dam*, 1½ miles above the Little South Branch. Mean of two measurements, checked from

Fredericton 942 feet, from Chatham 882 feet; hence *912* feet above the sea.

*Forks of Little South Branch.* By estimation 50 feet below the preceding, and hence *862* feet above the sea.

*Forks of Main South Branch.* Mean of two measurements, checked from Fredericton 301 feet, from Chatham 217 feet; hence *259* feet above the sea.

*Mouth of Dungarvon.* By estimation 10 feet below a station which, partly by checked measurements and partly by estimation, is 90 feet; hence *80* feet above the sea.

## 85.—On the Physiographic Characteristics of the Renous River.

Read November 1, 1904.

One of the least known, scientifically, of New Brunswick rivers is the Renous. In August last (1904), in company with my friend, Professor A. H. Pierce, I descended it in a canoe from near its source in North Branch Lake to its mouth in the Miramichi, and made the observations which follow.

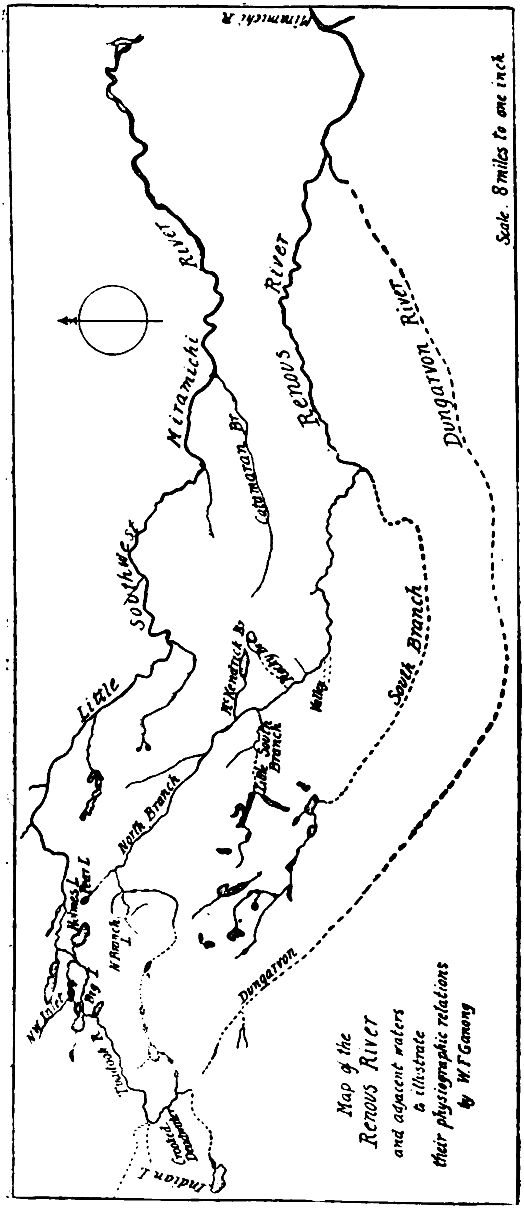
The development of our knowledge of the river may be briefly traced. Its first appearance is upon the remarkable Franquelin-DeMeulles map of 1686 (often mentioned earlier in these notes*), where it bears the name *Elchiquck,* the Dungarvon being called *Chibouchich.*** Following this map, it is shown, though very imperfectly, upon later French maps, while its modern representation begins with Bonner's map of 1820, where its lower course is clearly shown. It and the Dungarvon are sketched well up their courses on Baillie's maps of 1832, though with their names curiously transposed, but it is first laid down from survey, and to near the head of the South Branch, on Saunders' map of 1842, following surveys by Jouett in 1828 (from the mouth to above

* As under Note 77 (this Bulletin, No. XXII, Vol. V, 215).

** The modern Micmacs call this river *See-bo-o-sis* (plainly the same as Chibouchich), meaning "a little brook," which is curiously inappropriate. Its South Branch they call *El-de-gek,* which is probably the same word as DeMeulles *Elchiquek,* in which case DeMeulles has the names transposed, as he has in other cases. The name *Renous* is without question the possessive of the name of the Indian chief and family (Renou) living at the mouth of this river at the first settlement of the country. Its great branch, the Dungarvon, a longer river than the Renous itself, I hope to consider in a future note.

the grants) and 1836 (thence to the South Branch), and by Berton in 1838 (South Branch from the mouth of the lakes), though curiously enough, this map does not make use of Berton's survey of the North Branch also made in 1838. The latter survey is, however, used on Wilkinson's map of 1859 (though placing its head too far to the eastward), which also indicates the presence of lakes at the head of both of the South Branches, laid down in part from timber-line surveys of 1837 by Jouett. No substantial improvement over this map was made until very recently, even Loggie's of 1884 and the Geological Survey of later date making only slight and unimportant additions. It was the timber line surveys of recent years which mapped the lakes at the head of all three branches, the North Branch lake and water flowing into it* being laid down by Fish in 1894; and these are shown, though crudely, on the Crown Land Office map of 1898. The lower part of the river from above the South Branch to below the Dungarvon was re-surveyed (a sketch survey with distances estimated) by Loggie for the Renous and Dungarvon Salmon Club (now extinct), in 1896, and his large-scale plan is in the Crown Land Office. I have tried to utilize all of these materials in making the small-scale map accompanying this note. Turning from geographical to other recorded information, I have found surprisingly little. The geological map of the river is colored from observations made by Dr. Ells, who ascended the river to the Upper Falls in August, 1881, but he gives only two references to the river in his report (Report for 1880-1882, D, 9, 16). Dr. Chalmers appears, from references in his Report of 1894, to have ascended it as far as Dungarvon, but he makes no special mention of it. There are, of course, references to the river in many general works treating of the province, but none of them are of special importance. It does not appear to be mentioned in any of our sporting literature, aside from a brief reference to a visit to "the Renous lakes" by Dashwood in 1863 in his *Chiploquorgan* (110), and an article by Risteen, "The Phantom Loon of Louis Lake" in *Outing* for August, 1900. It is not a specially

* Excepting at the extreme head, which I have added from a sketch given me by Mr. Henry Braithwaite.




Map of the
Renous River
and adjacent waters
to illustrate
their physiographic relations
by W.F. Ganong

good river for game or fish. The river is settled thickly to above the Dungarvon, and sparingly still higher, chiefly by the descendants of Irish immigrants who came here from the lower Miramichi after 1832. Above it is a wilderness which has yielded great quantities of lumber.

The river falls naturally into parts as follows:

1. *From its source to North Branch Lake.*—I have not myself seen any portion of this section of the river except its mouth in the lake; but the timber line surveys, together with sketches given me by Mr. Henry Braithwaite, show its course to be approximately as indicated on the accompanying map. As will be shown in the next note, this valley appears to be morphologically an extension of that part of the Tuadook valley above the Crooked Deadwater, and, as there is low ground to the westward of the North Branch Lake, it is altogether likely that preglacially it flowed in a direct line into the lake instead of by its present circuitous route. The origin of this valley will also be discussed in the next note.

2. *North Branch Lake.*—This attractive lake (1176 feet above the sea) is pear-shaped, a mile in length by a half in breadth, rock and sand rimmed, and apparently deep. It lies in a considerable basin surrounded by heavily forested hills, though its immediate shore has been deforested by the damming of the lake. It exhibits two noteworthy features; first, its inlet is close to the outlet and occupies a marked valley extending to the southeast; second, its northwest shore is composed of extensive ledges of mica schist,* which have a strike in the direction of the aforementioned inlet. Since now, as will presently be noted, the present outlet is typically post-glacial, there is no question, I believe, that this lake basin emptied pre-glacially into the lakes to the south-east along the lower course of the present inlet, and the ledges mark a part of the old valley wall. This

* Determined from my specimens by Professor L. W. Bailey, who has kindly identified also the other rocks mentioned in this note. Of some huge boulder-like masses, some fifteen or twenty in number, of a remarkable dark granitic rock lying on a shoal on the southeast side of the lake, he says, they are composed of a mixture of horneblende mica and quartz, the dark metallic-looking constituent being mica, and it is probably intrusive. Evidently these masses have not been brought from any great distance, if indeed they are not simply detached parts of an underlying ledge of this material.

raises the question as to the location of the old head of the valley. The general morphological courses of the rivers in this section would imply that this old valley originally extended along the course of the portage to Holmes Lake, or else directly into Big Lake, and thence perhaps to Northwest Inlet. But the lowest point in the gap leading to Holmes Lake appears to be of considerable height, since the portage road rises some 150 feet above the lake, though of course this may be in part over drift. This part of the subject must await more careful study than I was able to give it.

3. *The Outlet of the North Branch Lake, to Pear Lake Stream.*—This part of the Renous flows through a gap in the hills east of the lake, over a bed of mica schist ledges, with heavy rapids and small falls down to its junction with Pear Lake stream, a distance of a mile. It is typically and without question post-glacial, and is the more interesting since it is the only post-glacial portion of valley throughout the whole extent of the river from the lake to its mouth.

4. *The Pear Lake Stream.*—This I have not seen above its mouth, but the appearance of the valley there, its precise continuation of the course of the valley below this point, and other considerations given in an earlier note (No. 55), all combine to show that this is the true morphological continuation of the Renous, and that in pre-glacial times it emptied the Tuadook lakes into the Renous. Closer study will be needed to determine its precise morphological head.

5. *From Pear Lake Branch to Little South Branch.*—Starting with a considerable deadwater, the river enters a boulder district, where it breaks up among islands and spreads out widely for a mile or two; it then traverses a series of deadwaters and pools separated by abrupt rips for a mile or more, after which it gradually becomes smoother with less fall and approximates to the gravelly type with stillwaters and pools, winding about amid occasional intervales, extremely pleasant to the canoeman. It continues to improve down to the old driving dam, where the boulders abruptly re-appear with much fall, making the river very rough; but gradually the boulders diminish, and the river becomes smoother down to the Forks of the Little South Branch.

Throughout this extent, including with the Lake Branch some 11 miles in length and 314 feet of fall (or under 30 feet to the mile), the river flows always over drift, though occasionally washing against ledges on one or the other (usually the left) valley wall, and no part of the river is post-glacial. In many places the valley is greatly narrowed by great heaps of drift, but nowhere does this fill the deep valley, so that the river was able to cut it out without being forced from its old course. The country has the peneplained character, the hills, densely forested, being well back from the stream, especially in the upper part of the valley, where they are 300 or 400 feet above the river; but they appear to lessen in height downwards, reaching not much over 150 feet, at least near the river, near the Forks. The physiographic origin of this part of the river seems, therefore, plain; it is in an old, pre-glacial, valley, no doubt one of the ancient radiating series from the central highlands. There is, however, an interesting possibility suggested by the curiously reentrant direction of McKendrick Brook, which enters the Renous in a pleasant basin, namely, that at one time this river emptied along the course of this brook, through Rocky Brook Lake and Catamaran Brook into the Little South West. I was not able to test this possibility by further observation of those waters, but it would be quite in harmony with other facts in the courses of the rivers in this region.

All along the river are frequent ledges, consisting above of the same mica schist which appears at Renous Lake, giving place, however, to fine-grained sandstone or quartzite lower, and somewhat ferruginous slates still lower. In only one place did I find granite in situ, namely, about three miles below the Pear Lake Branch; while half a mile below it the same schist as above reappears. The granite belt on the geological map should therefore be greatly narrowed.

6. *Little South Branch.*—This Branch I know only from hearsay. It has many small lakes at its head, which have been described to me by a lumberman as "very fine lakes." It is an insignificant stream at its mouth, much smaller than the North Branch. The general appearance of its valley here, combined

with the general river directions of this region and the presence of an apparent old valley at the big bend four miles below, suggests the possibility that the present Little South Branch is recent, if not post-glacial, and that its old course was into the above-mentioned bend.

7. *From Little South Branch to (Main) South Branch.*— For a mile below the Little South Branch the river continues open, pleasant and smooth; then abruptly its bed becomes choked with great numbers of huge boulders and acquires much fall, which conditions continue, with few and only local intermissions, down to within two miles of the Main South Branch, making this part of the river extremely difficult for canoe navigation, particularly at low water. The fall in this distance, 14½ miles, is some 603 feet, an average of over 41 feet a mile. This part of the Renous is without doubt the roughest piece of river of its size and length, at least in which the roughness is due to boulders, in New Brunswick. The bed is, however, invariably of drift, though ledges occur often upon one side or the other. The valley itself continues of much the same character as above, though apparently in places somewhat narrower. Its character is finely shown by the extensive views allowed by some elevated burnt country three miles below the Little South Branch. Here the country may be seen extending as a great plateau in every direction. remarkably level to the south and east, but rising somewhat into loftier ridges to the west, where, just below the Little South Branch, an elevated region appears to cross the river, doubtless continuous with the similar region described in an earlier note (No. 54) as crossing the Little Southwest Miramichi. Into this plateau the river has cut a somewhat wide and moderately mature valley, some 300 or 400 feet deep, so abruptly that one must needs be close beside the valley before he could be aware of its presence. Two miles above the main South Branch the river issues suddenly from this elevated region of ancient hard rocks into the much lower open country, formed by the Carboniferous sandstones, the edge of the former, as seen from the latter, presenting almost the abruptness of an escarpment. Thence the river flows more

and more smoothly, but ever swiftly, over coarse drift amid intervales and islands down to the South Branch.

Throughout this extent the ledges are always of slate or conglomerate (conglomerates resembling somewhat those of the Carboniferous appearing eight miles above the Forks, though giving way again to slates below), never of granite; yet the boulders which fill the river are mostly of the latter material, derived no doubt from the granitic interior, though their distance of transport is notably great.

The origin and development of this part of the river seem in general plain. It is wholly long pre-glacial, and no doubt a continuation of the old valley above, though it may be, in part at least, younger than the latter. Two possible former differences in the valley may be noted. There appears to be an old valley extending westward from the big bend four miles below the Little South Branch, through which the latter may originally have emptied. In this case it is very possible that the pre-glacial course of the waters of North Branch Lake was via the Little South Branch lakes to this point, as suggested by the map. Again the directions of the river suggest that formerly this river may have cut across from two miles above the South Branch by a shorter route to the river below, joining it a mile or two lower than at present.

8. *The (Main) South Branch.*—This branch I know only from hearsay. It has several lakes at its head, described to me by a lumberman as some ten or twelve in number, and "very fine lakes." At its mouth it is a beautiful smooth-flowing stream, apparently somewhat larger than the North Branch, and it is said to be easily navigable for canoes as far as the Lower Falls.

9. *From the Main South Branch to its mouth.*—Throughout its extent, this part of the river has the typical characteristics of all of our rivers flowing through the Carboniferous formation. In its eighteen miles to the Dungarvon it falls some 179 feet, or less than ten feet to the mile, while in the remaining eight miles to its mouth it falls 80 feet, or at about the same rate, a great contrast to the upper part of the river. It winds about over drift among intervales and terraces in a wide low-walled valley;

its bed is of shingle or sand, with occasional boulders; there are many long stillwaters separated by short rips of moderate fall, or by long smooth gravel reaches; the bank vegetation is dense and attractive; and altogether we have an extremely pleasant river. Two distinct types, with correlated beds, banks and scenery occur upon all these rivers in more or less regular alternation. There is, *first,* the intervale type, with low banks, elm and maple clad, often backed by level river terraces, with bed and banks of smooth gravel, sand and even mud, and with many stillwaters separated by gravel rips. *Second,* there is the clay bank type, in which the banks are steep, rounded terraces of boulder clay, bearing white birch, while the river bed is swift, shallow and obstructed with boulders left by the washing away of the finer materials, and forming often heavy rapids. In the settled district, the intervale type is well settled, while the clay bank type is not. Extensive ledges occur here and there upon one bank or the other (often forming considerable cliffs), and even partly in the bed of the river, but in no case does the river flow completely over ledges, and in no part is it post-glacial. In general, the valley becomes broader downward, and in its lower part it is thickly settled, especially on the intervales and terraces, and it becomes a very attractive river and very much larger than our maps imply. On one of its most typical parts the Dungarvon enters, apparently a smaller river than the Renous. Finally it empties through a somewhat narrower valley by a rather insignificant mouth into the Miramichi, forming, in all probability, as earlier pointed out (Note 50) the true morphological head of the part of the Miramichi below it.

In general the physiographic history of this part of the river seems plain. It is one of the ancient parallel series crossing the Carboniferous plain from southwest to northeast. One possible alteration of the original course may be noted. About half way from the South Branch to the Dungarvon the direction of the valley changes, its upper part pointing off to the Little Southwest Mirimichi; it seems possible that it may at first have had that course, the part thence to the Dungarvon being newer, and the Renous below the Dungarvon originally belonging to the latter river.

Such appears to be in outline the probable development of the Renous. With the exception of the lake at its head, its entire course has had from very early times a homogenous development. It is a remarkable fact about it that it has been so little affected by later changes, and especially that, except at its very head, it has nowhere been turned from its course by glacial changes.

## 86.—On the Physiographic Characteristics of the Southwest (Tuadook, or Crooked Deadwater) Branch of the Little Southwest Miramichi River.

Read December 6, 1904.

Our published maps give very erroneous impressions of the relative sizes of the larger rivers flowing from the interior highlands of the province. This is partly because their headwaters are so defectively, or even not at all, shown, and partly because their representation by single or by double lines, from which we largely infer their relative sizes, is not determined by actual size, but rather by the extent to which they are known and used. A conspicuous case of this error (aided perhaps in this instance by the presence of the word "Little") is found in the Little Southwest Miramichi, which is a far larger river, and geographically more important, than our maps imply. Rising as a small mountain stream on the Central Plateau, it is very soon enlarged by the entrance of great branches, of which two are of especial size and importance,—the Upper North, or Walkemik Branch, described in the succeeding note (No. 87), and the Southwest, or Tuadook Branch, in part described in an earlier note (No. 55), and in part now to be considered. Two other large branches, the North Pole and the Lower North Branch, are, I believe, approximately correctly shown on existing maps, while the very interesting development of the lower course of the river has been considered in another note (No. 54).

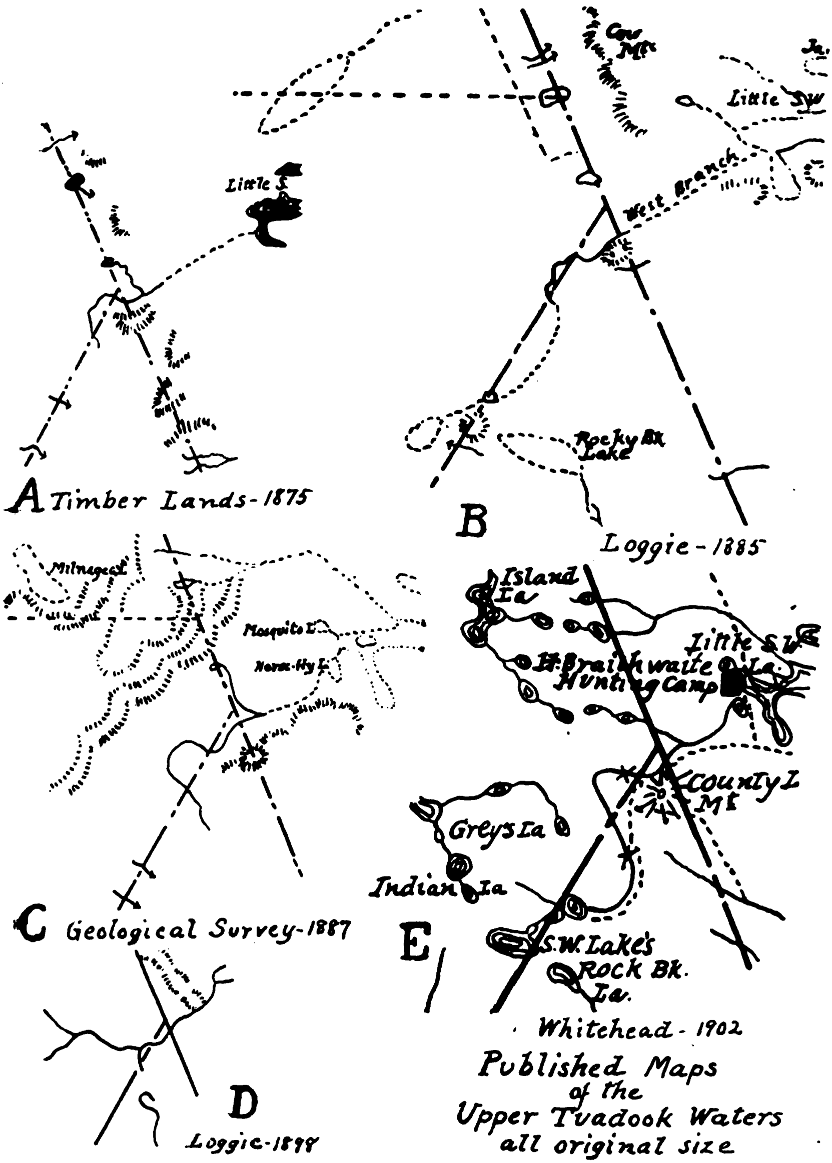
The Southwest (Tuadook, or Crooked Deadwater), Branch is composed of four distinct parts: (1) Indian Lake and its stream to Crooked Deadwater, (2) Crooked Deadwater, (3) the rapid stream thence to Big Lake, and (4) the Tuadook group of lakes.

The latter were treated somewhat fully in an earlier note (No. 55*), while the three former I shall here consider, following observations made on my visit to them in company with Professor Pierce in August last (1904). Their study was of particular interest to me, and long eagerly anticipated, because of their anomalous position directly across the general river trend of this region.

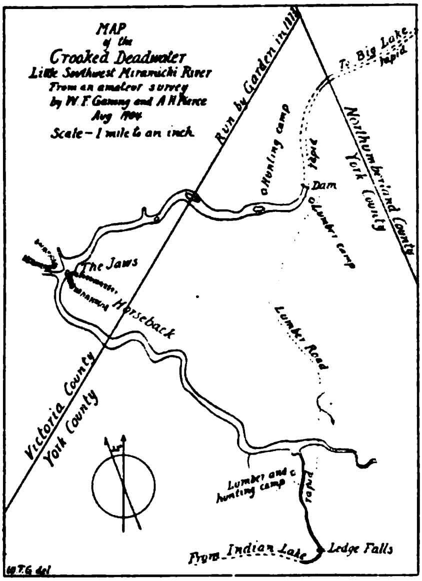
We consider first the development of our knowledge of these waters, and, because of their remoteness and difficulty of access, we find it all very recent. Their very first appearance in records is, as far as I have been able to find, as late as 1873, all maps prior to that time being an absolute blank in this region, and no published work of any kind making any reference to them. But in that year (1873) the Northumberland-York County line, surveyed by Malone, crossed the stream below the Crooked Deadwater, fixing its position; and later in the same year the York-Victoria line extended to meet it by Garden, crossed and located the Crooked Deadwater in two places, as well as minor streams in the vicinity. These surveys are the source of the first printed representation of this stream, that on the Timber Lands map of 1875. (See accompanying copies of published maps, A). It makes no other appearance until 1885, in which year Loggie (Map, B) adds on his map sketches of Rocky Brook (Moose) Lake, and Indian Lake (without name), without doubt from information supplied by Edward Jack, who, as will presently be noted, was here in 1883. The later Geological Map of 1887

* To which certain *addenda et corrigenda* may be noted. The visit of Messrs. Long and Cox to the lakes, a little over a week instead of several weeks in length, is described by the former in *Outing* for October, 1902. I find also that Dashwood visited the lakes; he gives an interesting account of his trip in his *Chiploquorgan*, page 100 *et. seq.* Edward Jack ran a timber line across them in 1873, and was there again in 1883, as recorded later in this paper. Before that Colonel Maunsell with a party including two ladies, portaged from Long Lake to Big Lake and descended the river; he gives an account of his trip in some journal not at present known to me. There is also a very interesting narrative of a hunting trip to these lakes in *Forest and Stream*, December 22, 1894.

Dr. Ells tells me that he was not at these lakes, though he was at the Big Deadwater to the northward. A note in a paper by Mr. Jack mentions that Holmes, for whom Holmes Lake is named, was a lumberman who cut pine timber here. Also I do not correctly repeat Mr. Jack's remark about the absence of rock exposures in this country; he does not say there are none, but simply that he did not see any.


Little S
A Timber Lands-1875
Cow Mt
Little SW
West Branch
Rocky Bk Lake
B
Loggie-1885
Mosquito L
C Geological Survey-1887
D
Loggie-1898
Island La
H. Braithwaite Hunting Camp
Little SW La
County L Mt
Greys La
Indian La
E
S.W. Lakes
Rock Bk. La.
Whitehead-1902
Published Maps of the Upper Tuadook Waters all original size

(Map, C), keeps, however, to the earlier representation, as does the Crown Land Office map of 1898 (Map, D), though it adds a sketch of the branch running up towards Gulquac. No further advance was made until 1899, in which year Malone, in running a timber line for the New Brunswick Railway Company, located and sketched more correctly Indian and Moose Lakes (without names), though he introduced an error in the stream below. From this source Whitehead's crude representation (Map, E) in his Sportsman's map of 1902 was apparently in part taken.




No survey, however, of any part of these waters was made during this time, the representations being based solely on the intersections of streams with surveyed lines, supplemented by sketches. Accordingly our survey of the Crooked Deadwater, this summer, presented in the two accompanying maps, is the first of any part of these waters that has been made.* Turning from cartographical to other recorded information, we find equally little to note. The first account, or even mention, of the region I have found is in a very interesting MSS. lecture on a surveying trip to the Tuadook Lakes by way of the Crooked Deadwater, in 1883, by Edward Jack, which gives not only a very interesting narra-

* It was made from a canoe, with the angles taken by compass, and the distances estimated. It was then checked by adjustment to Garden's County Line survey. The remainder of the larger map is compiled from various sources, including the surveys above noted, personal observations, and especially a very detailed and valuable sketch map sent me by Mr. Henry Braithwaite, to whom I am indebted for much information, as well as other courtesies. No connection of these (Tuadook) waters with Tobique waters has been made, so that the map is probably inaccurate in this respect.

tive of his journey and notes descriptive of localities, but various observations on natural history as well.* No professional naturalist or geologist has hitherto reached the region, the representation of its geology on the geological map being simply inferential. The Crooked Deadwater has, however, been several times visited in recent years by the sportsman-writer, Frederic Irland, who refers to it in several of his writings, notably in "The Coming of the Snow," in *Scribner's* for January, 1897, and in "Hunting with Henry Braithwaite," in *Forest and Stream*, February 1, 1902. It is also mentioned by E. Hough, who was here in the winter, in *Forest and Stream* for November 1 and 8, 1902, and I have also seen other scattered references to this famous hunting ground in the same journal and elsewhere, though none of importance. The region is of course unsettled, but Mr. Braithwaite, doyen of New Brunswick guides, has hunted here since 1874, or earlier, and has several camps in the region, to which he takes sportsmen every year. Recently it has been lumbered for spruce, leaving camps and a dam as noted on the maps. All of the lands represented on the map west of the Northumberland County line belong to the New Brunswick Railway Company, with the exception of a small area shown on the map, which, with all of the lands to the east of the afore-mentioned county line, are Crown Lands.**

We consider now the several parts of this interesting river.

1. *Indian Lake and its Stream.*—Indian Lake is one of the most charming, as it is one of the most remote, of New Brunswick lakes. It lies in an east and west direction in a nook, as it were, well up (1612 feet above the sea) towards the summit of the great Central Plateau, which nearly surrounds it with finely forested hills, culminating in three prettily wooded summits some

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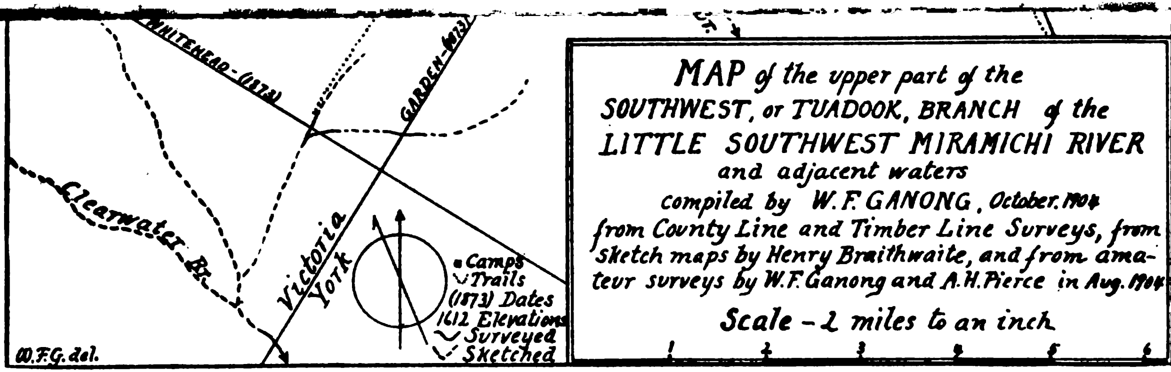
* The MSS. is in possession of Mr. D. R. Jack, of St. John, to whom I am indebted for the use of it. It is to be published with annotations in an early number (probably April, 1905,) of the magazine, *Acadiensis*.

** The place-nomenclature appears to be entirely descriptive and recent. Most of the names, perhaps all, have been given by Mr. Braithwaite; some are obviously descriptive, and of the others he tells me *Parker*, *Chestnut*, *Rumsey*, *Kipler* (as it should read on the map) are for sportsmen he has guided there, and *Indian Lake* commemorates his finding fourteen Indians camped there on his first visit.


MAP of the upper part of the
SOUTHWEST, or TUADOOK, BRANCH of the
LITTLE SOUTHWEST MIRAMICHI RIVER
and adjacent waters
compiled by W. F. GANONG, October. 1904
from County Line and Timber Line Surveys, from
sketch maps by Henry Braithwaite, and from ama-
teur surveys by W. F. Ganong and A. H. Pierce in Aug. 1904
Scale - 2 miles to an inch
1 2 3 4 5 6
Camps
Trails
(1873) Dates
1612 Elevations
Surveyed
Sketched
WHITEHEAD-(1873)
GARDEN-(1873)
Victoria
York
Clearwater Br.
W. F. G. del.

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four hundred feet over its surface and closing its western end. These hills show four breaks. First there is a gap towards the southwest in the direction of the Clearwater, and it may indicate some former connection with those waters. Second, there is a valley entering from the north-northwest; it is apparently occupied by the only inlet of the lake, and is in part followed by the trail to Parker Lake, a typical shallow mud-and-reed lake higher up on the Plateau and now emptying westward, though perhaps originally belonging to this valley. Third, there is the present outlet to the eastward. Fourth, there is a gap to the east-southeast in the direction of Moose Lake, which is followed by the trail to that lake. Moose Lake is another very charming hill-encircled, or, rather, plateau-encircled lake, lying now sixty-one feet higher than Indian Lake and hence 1673 feet above the sea, and, evidently, the highest lake of any size in the province. The watershed between these two lakes, however, is but little (only a few feet) above Moose Lake, and it seems not improbable that Moose Lake emptied in immediately pre-glacial times through this gap into the Indian Lake valley, in which case the outlet of Moose Lake through Rocky Brook will be found to be post-glacial. However this may be, these two lakes appear to me to occupy parts of a single ancient valley which headed on the plateau not far from Parker Lake and ran southeast across both of these lakes by way of upper Rocky Brook into Dungarvon waters (a branch south of the parts shown on the map), and it is possible this may be the true morphological head of the latter river. While all observed facts, together with the analogy of the river directions in this region, would make this the original direction of flow of these waters, it is evident that it has long been modified, and that in times long pre-glacial, Indian Lake, and perhaps (as above noted) Moose Lake also, flowed by the present course to the Crooked Deadwater.

The present stream from Indian Lake to Crooked Deadwater flows with much fall (262 feet) eastwardly and northeastwardly through a somewhat narrow, winding, drift-bottomed and obviously pre-glacial valley some four miles, when it suddenly turns north to flow into the Crooked Deadwater. Just at the turn it

falls over schistose ledges in a bed that is obviously post-glacial.* Its pre-glacial course I was not able to trace, but the topography of the region suggests either one of two directions: first it may have flowed northward across the present head of the Crooked Deadwater in a more or less direct line to the present outlet near County Line Mountain; or, second, it may have flowed more to the eastward through the chain of small ponds and lakes into Renous Lake. Whether or not the latter was its immediately pre-glacial course, there can be little doubt that at some comparatively-recent period it flowed in this direction, and that there is a single continuous valley all the way from Indian Lake to Renous Lake, homologous in origin with the parallel valley to the northward, later to be mentioned.

2. *The Crooked Deadwater.*—This part of the river is very expressively named, for throughout its extent of over three miles it is a typical deadwater, winding about in a flat basin amidst typical flat spruce bog. It is not a continuation of the Indian Lake Stream, for the latter is a branch of it, but it heads in a small, clear sluggish stream coming, as Mr. Braithwaite tells me, from a little pond to the eastward, and it ends at the dam near County Line Mountain, where the rapid water begins. In places it is narrowed and made shoal by boulder trains across its course, and in one prominent place, "The Jaws," it is narrowed from its usual thirty to fifty yards down to some ten yards by the presence of a striking horseback which the stream has cut directly across. The horseback has a direction northwest and southeast, and can be traced some distance southwesterly. It is obviously the presence of this horseback, thrown directly across a flat basin, which has given the upper part of the Crooked Deadwater its anomalous northwesterly direction; it formed a dam to the waters above it, and these fell over, and cut into, it at its lowest point, which happened to be at the present Jaws.**

From the many windings of the Deadwater one gains fine views of the surrounding hills, especially of the grandly-forested

* The ledges of this place yielded the only rock I was able to find in the Crooked Deadwater region. It is a schist with veins of granite.

**Edward Jack, in his MSS. earlier mentioned, states that this was formerly a great crossing place for lynxes, which were trapped here in large numbers.

County Line Mountain, rising abruptly some 700 feet above the water (and hence 2045 above the sea), and of the great central plateau to the westward, with its clear-cut edge well-nigh as level as the ridge of a roof. Four great gaps, however, appear in the encircling hills. There is one to the northwest, occupied apparently by the stream heading up near Milnagek or Island Lake, and there is another towards the southeast in the direction of the Dungarvon. I have no question that we are here concerned with a single ancient valley, the morphological head of this part of the Dungarvon, cut by an ancient river, which, rising on the plateau near Fox Lake, originally flowed across the present Crooked Deadwater into the Dungarvon. This connection must, however, have been ancient, since the present outlet to the eastward seems of considerable antiquity, and long pre-glacial. Noting the direction of the valley towards Milnagek Lake, the question arises whether the latter also may not have been included in this ancient valley. But all evidence tends to show that such was not the case, and that the watershed between these waters and Milnagek is extremely ancient. Indeed, so far as our present river systems are concerned, this central plateau is the primitive or original watershed of the province. From it the rivers have, from the earliest times, radiated southeasterly and northwesterly, but, in this region, they have never crossed it. As shown in earlier notes (Nos. 39, 55, 56), it is an irregular, often very sharply bounded, plateau, 1700 or 1800 to 1900 feet above the sea, and locally higher, on which occur many shallow ponds, and numerous rivulets, the interlocked sources of the rivers flowing in both directions.

Two streams enter the Crooked Deadwater on the northwest side at the Jaws, one on each side of the horseback. The larger of these rises far off to the northwest, even to within two miles of the Gulquac. I was not able to trace it myself (the sketch on the map being given me by Mr. Braithwaite), but either it or the smaller stream near it appears to occupy in part a pronounced break or valley extending off to the westward, which seems to represent the westerly continuation of the valley emptying these waters easterly into Big Lake.

The Crooked Deadwater region is a famous hunting ground, replete with moose and other big game.

3. *The River from Crooked Deadwater to Big (Tuadook) Lake*.—This part of the river occupies a valley cut deeply, some 400 or 500 feet, into the plateau, but fairly broad and moderately mature. It has much fall, over 200 feet in about five miles, and is almost continuously rapid, flowing usually, if not entirely, over drift. It is obviously long pre-glacial in origin. and as above noted, it is a part of a valley extending off to the westward. It seems plain that this valley is homologous in origin with the parallel valley to the southward of it, that extending from Indian Lake to Renous Lake. But the question as to their mode of origin is one of the most puzzling in all the range of New Brunswick physiography, and I sought in vain during my two visits, in 1901 and 1904, to find some clue to its solution. Since these two rivers cut directly across at right angles to the general original river-trend of this region, which is plainly northwest-southeast, and since these valleys are obviously newer than the more ancient series, I can only surmise that they owe their origin to some local causes, whether softer rocks, fault lines, ancient glacial phenomena, or other, is still to be determined. We appear to have a similar problem in certain other parts of the province, namely, in the part of the Nepisiguit between Indian Falls and Grand Falls, and in that part of the Main Southwest Miramichi between the North Branch and Fall Brook.

Thus, although much is still doubtful about the origin of this exceptional river, enough is evident to make it reasonably certain that it is a remarkably composite system, consisting of parts of two ancient northwest-southeast valleys, cut across and captured by two later northeast-southwest valleys, the whole modified in some details by glacial action.

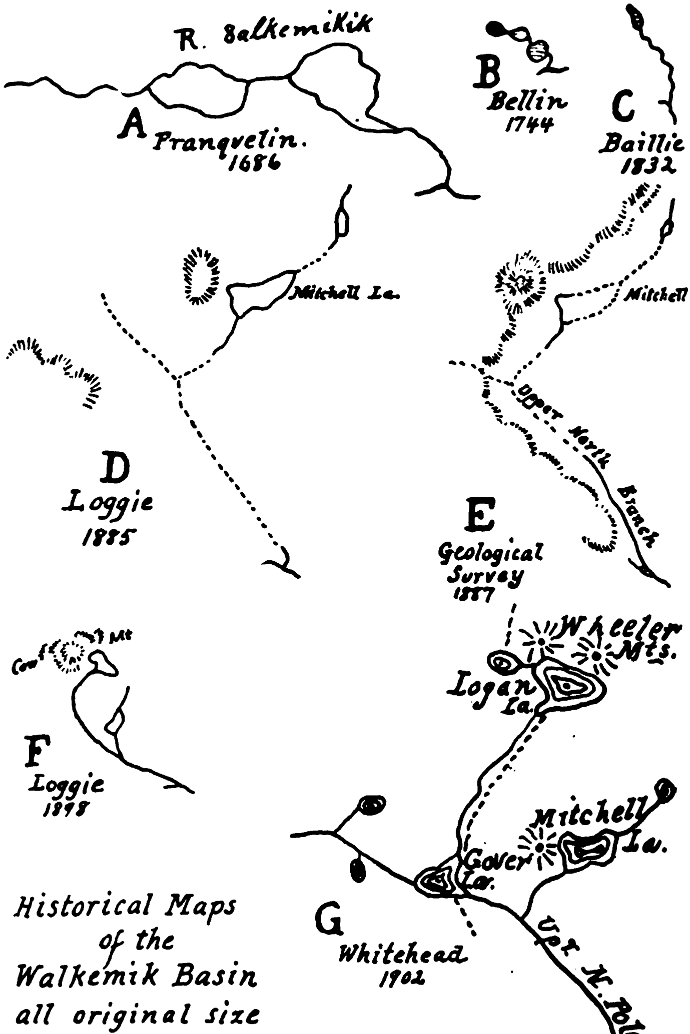
## 87.—ON THE PHYSIOGRAPHIC CHARACTERISTICS OF THE WALKEMIK BASIN (UPPER NORTH BRANCH OF THE LITTLE SOUTHWEST MIRAMICHI).

Read December 6, 1904.

The Little Southwest Miramichi River, rising as a small mountain stream on the central plateau, is rapidly enlarged by the confluence of several great branches, of which two are of especial importance,—the Southwest or Tuadook Branch, considered in the preceding note, and the Upper North or Walkemik Branch here to be described. The large basin of this branch, including several fine lakes, lies in the very heart of the New Brunswick Highlands, and, because of its remoteness and difficulty of access, has been hitherto little visited, scantily surveyed, hardly at all mentioned in print, and wholly unstudied by any scientific men. In this region, thus so attractive, I spent somewhat over three weeks in July and August last (1904) in company with my friend, Professor A. H. Pierce, studying the natural phenomena of the country, and mapping by plane-table and traverse its lakes, streams and hills.* Our results are presented upon the accompanying map and in the observations which follow.

We trace first the development of our knowledge of the basin. Its waters appear first and unmistakeably, upon the remarkable Franquelin-DeMeulles map of 1686, as shown by the accompanying copy (Historical maps, A), and it bears the name 8alkemikik (or, as we would spell it, Oualkemikik), without doubt its Micmac Indian name. Since some concise name for this branch is needed, as an alternative for its present very cumbersome designation (viz., "Upper North Branch of the Little Southwest Miramichi,") I have adopted this appropriate name in the sim-

* We portaged from Portage Lake, Tobique, without guides or other aid, by way of Hind Lake and the other lakes and ponds of Adder Lake Stream to Upper Graham Plains, and thence to Gover Lake, where we established our base camp. We did not know of the new portage road from Portage Lake to Gover Lake until too late to make use of it. Afterwards we descended the Upper North Branch, studied briefly the Crooked Deadwater and Indian Lake region, and came out by the Renous.




Historical Maps
of the
Walkemik Basin
all original size

plified form of Walkemik (pronounced Wal-kem-ik'), which may be applied both to the branch and to its group of lakes. The Franquelin-DeMeulles representation is followed, though not accurately, by Bellin of 1744 (Map, B), and other French maps, but the first modern map to show it is Baillie's of 1832 (Map, C), which lays it down, of course from reports, as an insignificant branch. The mouth of the branch is located, without name, on Berton's MSS. plan of the Little Southwest of 1838, but it makes no other appearance until 1884, all of the published as well as MSS. maps made in the meantime being an absolute blank in this region, although the name Upper North Branch is applied by Wilkinson, 1859, to the present North Pole Branch. In 1884 the very first survey in any part of the basin was made; in that year R. H. Lyle ran timber lines (noted on the accompanying large map) which crossed its waters in several places and intersected Mitchell Lake, which he sketched and named. His plan (the original is in the Crown Land Office) was followed by Loggie in 1885 (Map, D), and by the later Geological Survey map of 1887 (Map, E), which latter also adds a few fanciful and erroneous hachures. No further advance was made until 1896, when W. B. Hoyt ran timber lines, as noted on the large map, locating and sketching Dunn (or Logan) Lake and other parts of the system, and his plan is the original of the Crown Land Office map of 1898 (Map, F). In 1900 Hoyt ran other lines, and in 1903 W. Malone ran yet others, one of which located and allowed of a sketch of Gover Lake, and all of which are shown on the large map. The map of the Adder Lake Stream basin of 1902, made by Mr. Furbish and myself (these notes, No. 63), located the headwaters of two of the Walkemik branches, including the remarkable Patchel Brook. The Sportsmen's map by Whitehead of 1902 (Map, G), and the very small-scale map by Hough in *Forest and Stream* for November 8, 1902, are in part from the above sources and in part sketched. Thus down to this summer, while the principal lakes and streams had been located in certain points, none of them had been actually surveyed, and the accompanying larger map is accordingly the first to be made from actual survey of these waters. The lakes have

been mapped by plane-table, the mountains by triangulation, and the streams by traverses, and the whole has been adjusted to the timber-line surveys of the region (as shown on the plans of the Crown Land Office), while the contiguous waters have been added from various accessible sources. All streams that are shown by continuous lines have been surveyed, while those in broken lines have only been observed or are inferred.

Of published references to the basin, I have been able to find but four. None of our earlier book-writing sportsmen visited it, nor is there any reference to it in any of the geological reports, or in other scientific literature, excepting my own brief references in Note 63 of this series, and my description of the remarkable Patchel Brook and surroundings in Note 64. There is an account of a hunting trip to Gover Lake and Upper Graham Plain by Frederic Irland in *Forest and Stream* for February, 1902, and there is some mention of the region by E. Hough, who passed through it on a winter trip from the Nepisiguit, in the same journal for November 1, 1902. Other than these, no published references to the region appear to exist. It was first lumbered for pine in the early seventies by John McDougal, and some of the old pine hauling roads can still be seen and are used as trails. The first lumbering for spruce, however, began last winter (1903-1904), when M. C. Craig, of Perth, cut a portage road from Portage Lake to Gover Lake, built a camp at Gover Lake, and cut much good lumber in the vicinity. The basin abounds in big game, and is being gradually opened up to sportsmen by Mr. Henry Braithwaite, who first hunted here in 1884, and who has since opened trails and built camps as shown on the large map.*

* We may here note the origin of the place-nomenclature on this map. *Mitchell Lake* was named by Lyle in 1884 (as he once wrote me), in honor of the Surveyor General then in office, Hon. James Mitchell, and he named also *Dark Lake* and *Moccasin Lake*, both descriptive names, the latter of its shape. *Dunn Lake* was named by Hoyt in 1896 in honor of the Surveyor General of that time, Hon. John Dunn, and he also named *Cave Brook*, descriptively. Most of the other names were given by Mr. Braithwaite, as he informs me; some are evidently descriptive, such as *Caribou Brook, Sable Mountain, Pot-hole Brook, Thunder Mountain, Birch Lake, Portage Brook, Skunk Lake*, and, presumably, *Devils Lake*. Others are for sportsmen he has guided there, as *Graham Plains* and *Lake, Garrett Lakes, Wheeler Mountains*, or for lumbermen, as *MacDougal Lakes* and *Reeds*

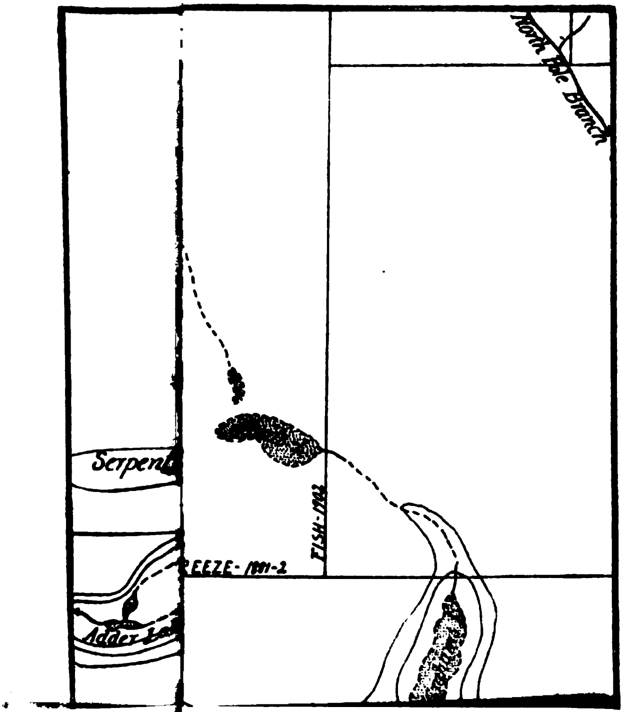
The mind of man is so constructed that it is prone to imagine things rare and choice in places remote and hard to reach, and so we looked forward hopefully to finding something especially worthy of note in these distant parts. But in fact nothing remarkable was met with, though many facts of minor interest, here set down, did result from our journey. Indeed it would not be difficult to predict the character of the region from an inspection of its geographical and geological position, for, lying as it does in the central crystalline belt, which is predominently granite, it displays all the distinctive characters to be expected in such a position—the boulder-strewn irregular surface, with much inferior spruce-heath forest, the obstructed drainage with its many shallow lakes and ponds, the dark waters with their abundant bog and muddy bottoms. It is a typical grainitic region, though more attractive than such places usually are because of its fine hill views and the great abundance of its animal life.

The Walkemik basin is hollowed out in a remarkable manner from the great central plateau of the province. This plateau, much dissected to the southward, is still almost intact upon the west and north. On the northwest it has an apparent elevation of some 1900 feet above the sea, and 500 or 600 above the basin, down to which it slopes with much abruptness. Its edge is here emargined by the sources of some of the streams, but apparently

*Lake*, while *Logan Lake*, *Gover Lake* and *Patchel Brook* were for men employed by him at those places, and *Smiths Lake* for an old hunter. The names on Serpentine waters, *Wigwam Pond* and *Kains Lake* and *Ridge Mountain* were given by Mr. Furbish and myself in 1902 (Note 63), and we named *Bertons Ridge* and the *Big Deadwater* in 1901 (Note 55). This year Mr. Pierce and I have given new names to previously unnamed places; following the suggestion given by the presence of the names of two surveyor generals, we have tried to honor the names of some of the principal men who have been connected with the administration of the Crown Lands of the province, and have named *Loggie Mountains*, *Wilkinson Mountain*, *Lockwood Mountain*, *O'Connor Mountain* and *Sproule Mountains*, as noted later in this paper. We have also named *Middle Brook* and *Pocket Pond* descriptively, and *Tendon Ponds*, in recollection of an accident one of us had there. *Senda Lake* we have given for a friend of ours. We have also ventured to transfer the name *Hough* (for the sportsman-writer earlier mentioned) from an apparent application to the ridge likely to be confused with Wilkinson Mountain to the little lake previously unnamed. *Cow Mountains* (wrongly applied by Hoyt in his plan to Thunder Mountain) is said by E. Jack, in a MSS. lecture of his of 1883 (mentioned in the preceding note) to be a lumberman's name, probably in allusion to Cow Moose, but I suspect it is an alteration or corruption of "County Line Mountains."

it is nowhere cut across. As it swings around on the north of the basin its margin has almost the abruptness of an escarpment, and in the angle is it partially cut across by Patchel Brook, as I have described in an earlier note (No. 64). Farther east it rises abruptly into the greater height of Thunder Mountain, 2468 feet above the sea, and one of the conspicuous mountains of the province. It extends thence northeasterly seemingly as a partially-separated ridge, which rises northward into a still unnamed higher mountain, which must considerably exceed 2500 feet in elevation, which I propose should be called *Wilkinson Mountain* in honor of the well-known provincial geographer, John Wilkinson.* Eastward of this, as seen from the southward, the country appears to fall off somewhat, but it undoubtedly continues eastward as a plateau, approaching 2000 feet above the sea, until it meets the plateau country about the South Branch of Nepisiguit, as already described in these notes (No. 77). From the Thunder-Wilkinson group a very elevated country, including the high summits of Nalaisk, Edward, Winslow, Gordon, Head and Saga mook extends to Nictor Lake, forming, without question, the highest mass of land in the province. So much for the great central plateau which is continuous. But off to the southward are many fragments of it, detached by erosion. One of the most prominent and important of these lies south of Dunn (Logan) Lake, including two elevated, with some lower, summits. These are still unnamed but I would propose they be called the *Loggie Mountains* in honor of the present capable and courteous chief draughtsman of the Crown Land Office, the principal summits being known as the North and South Loggie Mountains. Off to the eastward of these lies a somewhat isolated mountain which might well be called *Lockwood Mountain,* from an early surveyor-general and cartographer of the province, Anthony Lockwood.

* This summit is not visible from anywhere in the immediate vicinity, but it can be seen from several places at a distance. Thus I believe it is visible from the hills south of Mitchell Lake; I have also recorded it in my notes relating to the hills visible from Nalaisk Mountain on the Serpentine. But the best view of it by far is obtained from near the southern end of Holmes Lake, where Thunder and Wilkinson can both be seen with great clearness, Wilkinson rising markedly above the other. Its location on the map is only an approximation, but it is not, I think, far from its true position.



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Another detached part of the plateau is the elevated ridge, with three recognizable summits, just southeast of Mitchell Lake, and I would propose for this the name *Sproule Mountains,* for the first surveyor general of the province, one whose services deserve the grateful remembrance of our people. Another but smaller fragment is the conical mountain just east of the junction of Mitchell Lake outlet with the main stream, and for this I would suggest the name *O'Connor Mountain,* for Mr. Loggie's predecessor in the Crown Land Office. Another detached part of the plateau occurs in a remarkable unnamed ridge to the eastward of Portage Brook, and there are yet others to the southward, of all degrees of prominence.

The source of the Walkemik Branch is the little stream falling from the plateau into Hough Lake, which is really an extension of Dunn Lake and separated from it only by flat bog. Dunn (or Logan) Lake is, of all the considerable lakes of the province, the most remote and difficult of access, the most unspoiled (for it has never been lumbered even for pine), and almost the finest in its hill scenery,* being second in this respect only to Nictor, and perhaps Upsalquitch. It lies part way up the slope from basin to plateau (1576 feet above the sea), has rock-bound shores all around, except for some bog and marsh at its upper end and a sand beach at its easterly end. The huge granitic boulders of its shores support only a sparse spruce-heath forest. It is apparently deep, and empties from one side by a post-glacial outlet over a huge moraine. The surrounding splendidly forested hills are broken only in three places, to the northeast from Hough Lake where a valley exists; to the west, where the present outlet lies, and to the southeast where a low valley extends away, occupied in part by a small stream. In line with this is another brook (as Mr. Braithwaite has shown on his sketch map), emptying into Mitchell Lake, and beyond in the same line is Portage Brook, emptying into the North Pole Branch. I have no doubt that the pre-glacial outlet of Dunn Lake was

* I believe this is the lake called by the Micmac Indians *Wel-a-teg-e-ok,* or "Lake surrounded by hills," a name applied by them to some lake on this branch, as I am in formed by Mr. Wm. McInnes, of the Geological Survey of Canada.

along these valleys sortheasterly into the North Pole Branch, of which, perhaps, this lake forms the morphological head.

The outlet of Dunn Lake forms a very pretty torrent over the boulders for a quarter of a mile or more, when it becomes a rough bouldery stream which empties into a series of long boulder-bordered deadwaters or ponds, the Tendon Ponds, lying in a flat basin. The uppermost of these receives also the outlet of a series of very pretty clear-water little lakes (MacDougal Lakes, of which the uppermost, Senda Lake, is especially attractive), extending close up under Thunder Mountain, and fed by mountain streams from its slope. Below the deadwaters the stream flows with little fall, largely over a gravelly and sandy bed, down to Gover Lake, receiving the outlet of the pretty Garrett Lakes and the important Patchel Brook. This brook is formed by the confluence of two large branches, one coming down between Thunder and Ridge Mountains, forming a mountain torrent which has cut deeply into the mountain rocks, and another which rises on the Upper Graham Plains and has cut the very remarkable deep gorge which I have described in an earlier note (No. 64). There is no doubt, I think, that the latter branch is the true morphological head of the Walkemik Stream, and that its pre-glacial predecessor extended across Lower Graham Plains, through Gover Lake and along the present Walkemik valley to near its mouth, forming one of the primitive northwest-southeast series of rivers radiating from the Central Highlands. Both of the branches of Patchel Brook leave the mountain gorges abruptly and cross a heavily-wooded boulder-strewn plain in very irregular courses difficult to follow. Gover Lake, 1292 feet above the sea, the drainage centre of the basin, is an irregular shallow lake, with bog and boulder margin, and muddy bottom. In addition to the main Walkemik stream it receives three brooks. The first is a small, clear spring-brook from the east. The second, Middle Brook, runs along the southwest margin of the Lower Graham Plains. The third is Pot-hole Brook, which rises apparently on the margin of the plateau, and in its course to Gover Lake flows beside, and in some part through, the most extensive and finely-developed series of glacial sink-holes that I have seen anywhere

in New Brunswick. They are of all sizes and depths, from a few yards in diameter and depth up to considerable basins; some are wooded in the bottom, others are open meadow, others are bare rocks, showing evidence that they are lakes for a part of the year, while others are permanent and pretty little lakes. No doubt they are much more numerous than the dozen or more which we saw and whose general positions are shown on the map. This part of the basin appears to contain a series of parallel northwest and southeast moraines extending out from the western plateau, whose directions determine the courses of the brooks, which turn around their eastern ends into Gover Lake. The entire region exhibits glacial phenomena in great perfection, including the irregular moraines of Upper Graham Plains and the glacial gorge of Patchel Brook, earlier described (Notes 63, 64), the remarkable drumlin hills and islands of Mitchell Lake presently to be noticed, and the parallel moraines, the sink holes and other phenomena of this basin.

The main stream below Gover Lake flows southeast in a valley between a high and finely curved ridge (Gover Mountain) on the west and a lower ridge on the east, and, falling a few feet over boulders, with a possible granite ledge in one place, enters the first of a long series of lake-like deadwaters separated by short abrupt boulder rips. These deadwaters have the bouldery and boggy shores, irregular depths, and other characteristics of true glacial lakes, which indeed they are, of the simplest type. Into the second of these enters the outlet of Mitchell Lake.

Mitchell Lake, 1366 feet above the sea, is another very attractive lake of marked individuality. It is notably irregular in outline, with many islands and peninsulas, with abrupt low hills near it and loftier ridges and hills in the background. It exhibits one especially interesting feature, in which respect it surpasses all other New Brunswick lakes, namely, the islands, peninsulas and the abrupt rounded hills of the shores are all beautifully rounded glacial knolls of the drumlin type. Further, the distinctness and attractiveness of these knolls are greatly enhanced by the fact that they are in considerable part bare of forest, and covered only with a carpet of heaths, allowing their contours to

appear as plainly as if they were bare. The lack of forest is the result of former intense forest fires, which not only cleared a part of the south shore of the lake, but produced the extensive open dry barrens (Mitchell Plains) extending off a long distance to the southward. The surrounding hills show three breaks. First there is a low valley extending eastward and connecting with that of Portage Brook, flowing into the North Pole Branch.* This may be the route of the pre-glacial outlet of the lake valley, in which case it would have formed a branch of the pre-glacial stream which apparently emptied the Dunn Lake valley into the North Pole Branch. This introduces the question as to the origin of the east-and-west valley of the lake itself, but this I cannot explain, though the fact that it lies in part in a northeast-southwest line which includes Dark and Moccasin Lakes** suggests a possible origin homologous with that of the Upper Tuadook and Upper Renous-Indian Stream valleys considered in the preceding note. The second break is on the northwest, though it is not well marked. It may, perhaps, indicate an early connection with Dunn Lake in this direction, though such appears unlikely. There is some evidence also of a valley directly westward, and it may be that the drumlin hills of Mitchell Lake represent the finer glacial debris washed by this route from the Gover Lake Basin, in which all the glacial material is very coarse. The third break is to the southwest, followed by the present outlet. The entire country crossed by this stream is flat and open, evidently an extension of the Gover Lake Basin. The stream flows with but moderate fall over drift,—in its upper course over boulders and in its lower course partly over gravel,—but I was unable to find anywhere along it any clear evidence as to whether

* I have not yet been able to visit the North Pole Branch, but Mr. Braithwaite's description of it as, for the most part, a fine canoe stream, would indicate that it occupies a very ancient valley. The maps show a great bend in the river just below where Portage Brook enters it; it is very likely this bend represents a post-glacial course, while the pre-glacial course is directly across the bend, a subject I hope later to be able to study, especially as its head waters also offer some curious problems.

** Dark (Birch) and Moccasin Lakes are both attractive (especially the latter) forest encircled lakes. Reeds Lake, much more elevated, is apparently shallow and with low shores, but is said to contain large trout.

its course is here certainly pre- or post-glacial, though the former seems much the more probable. Its present course cannot, however, be very ancient, since it runs directly across the prevailing northwest and southeast drainage characteristic of this region, though possibly it may run in a part of an old northeast-southwest valley as already noted. On the other hand there is evidence that a small part at least of its course falls in an ancient valley of the northwest-southeast series. An inspection of the map will show that the chain of McDougal Lakes, the Garrett Lakes, the small brook emptying into the Mitchell Lake outlet a portion of that outlet,* and one of the Caribou Lakes all lie in a line, which line, as the Crown Land plans show, points directly to the head of Indian Brook. I think it is possible we have here another of these ancient parallel northwest-southeast valleys, the third in the Walkemik system.

Below the Mitchell Lake outlet the river flows through three or four deadwaters similar to those above, with the usual bouldery rips between, then by a rough boulder-strewn stream, often with high rocky valley walls on one side or the other and with much drop, into the lowermost (and one of the largest) deadwaters on the river. Below this it becomes an extremely rough stream, one of the roughest in the province, falling heavily amongst huge boulders between steep banks of coarse glacial drift. It soon swings out of the prevailing southeasterly direction, and turns to the southwest, falling still more in a yet rougher channel, not only over boulders, but over schist and granite ledges crossing its entire bed. This part of the river below the bend is obviously post-glacial, flowing apparently in a trench 25 to 50 feet deep cut into level glacial deposits. Although I was not able to trace the pre-glacial course of this part of the Walkemik valley, I have no

* My survey of this stream made it swing more to the east in its middle portion, indeed carrying it across the position of Lyle's timber line; but as that line shows no crossing streams, I have adjusted it to the position on the map. I had a somewhat similar experience in my survey of Mitchell Lake. I made it much longer than represented on the map, but as Lyle's original plan of 1884 shows an apparently chained line, making the lake 1 1-4 miles in length along its axis from his north line, I have shortened my survey to fit these dimensions. It interests me to find, however, that a former letter of his to me gives the length of the lake as 1 3-4 miles.

doubt it will be found continuing the line of the deadwaters across to the Little Southwest. Finally the river enters the valley of the Little Southwest, becomes abruptly more gentle in its character, and joins that river in a huge deadwater.

It is of interest to note now the relations of the waters of this basin with others adjacent. On the northeast runs the North Pole Branch, whose head swings around to approach Dunn Lake on the plateau northeast of that lake, where their relations are still to be worked out. On the northwest come the sources of the Serpentine (Tobique), and in one place, at the head of Patchel Brook, these two systems are separated only by a slight rise of ground a few yards across (Note 63). On the west the Little Southwest itself runs parallel with the Walkemik. I was not able to follow the Little Southwest to its source, as I desired, but one branch heads in a notch on the plateau which can be clearly seen from the eastern end of Gover Lake, while, as Mr. Braithwaite tells me, the main stream swings to the westward and heads in two little lakes near the County line. The intersection of timber lines and the Portage Lake portage road with this river shows that its general course must be about as sketched on the map, though its course is still wholly unsurveyed. Obviously it is another of the parallel valleys of the primitive northwest-southeast series.

In general, therefore, the physiographic history of the Walkemik basin seems to be plain. It is a composite of two or three ancient northwest-southeast valleys which have been thrown together partly by ancient cross erosion and partly by glacial changes. It still remains a question how the Gover Lake basin here became so extensively eroded, even the abundance of streams hardly explaining its depth and extent, much less the extreme sharpness of the transition from it to the plateau. It is perhaps homologous in age and origin with the great Silurian plateau north of the Highlands. Further study may show that softer rocks occurred here, even though no traces of them were noted by us.

The geology of the Walkemik basin, not having been studied at all heretofore, naturally excited our interest. But the entire

country is so heavily buried in drift and covered by forest that extremely few rock exposures were seen. On Patchel Brook granite and felsite both appear (Note 63), while on Upper Graham Plains there are considerable ledges of schist. The upper valley of the eastern branch of Patchel Brook has cut deeply into schists, and the stream at the head of the MacDougal Lakes has cut into granite. No other exposures were found, except a doubtful ledge of granite below Gover Lake, until the lower course of the river was reached, when ledges of schist and granite were passed, as noted on the map. The distribution of rocks shown by these, with some other, facts will be considered in the next note.

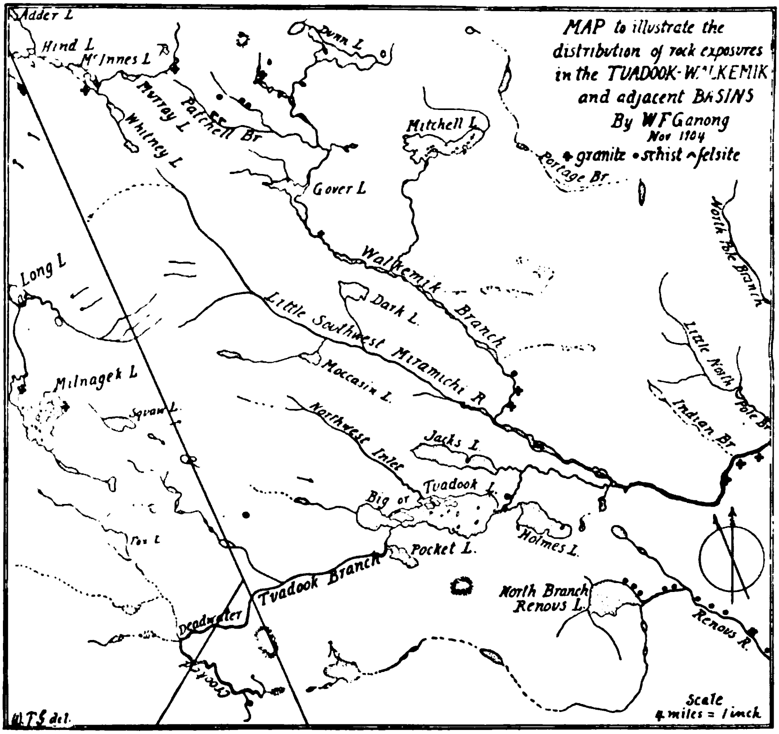
The vegetation of the region presents no features of especial interest. It is all heavily forested, with the exception of three great open areas, the Upper Graham Plains, Lower Graham Plains, and the Mitchell Plains, all of which have been opened by early fires, and now bear the plants of open dry barrens. In places, especially along the river below the Mitchell Lake outlet, these barrens are growing up to forest, the two characteristic trees being the Princes Pine (P. Banksiana) and the American Larch (L. Americana). The forest on the ridges is the usual mixed growth of the typical New Brunswick forest type, including some good pine and spruce, while on the lower levels and around the lakes and deadwaters it is chiefly of the worthless black spruce-heath-hypnum type, characteristic everywhere of granite boulder districts.

The region is extremely rich in big game, especially in moose, caribou and deer. Beaver are also abundant, and are building new dams and other extensive work at several points, notably at the inlet of Hough Lake, and at the inlet of the eastern end of Dunn Lake. Probably in no part of New Brunswick are the large animals so abundant and so little disturbed.

## 88.—On Geological Boundaries in the Tuadook-Walkemik Region.

Read December 6, 1904.

The geological boundaries laid down on our geological maps are, in much of the Central Highland region, necessarily largely conjectural. These parts have been little visited, in some large areas not at all, by geologists, and so completely is that




country drift-buried and forest-covered that ledge-exposures are very hard to find. During three visits to the area shown on the accompanying map, I have noticed ledge rock in the places indicated by the symbols. These facts will necessitate a considerable change in the boundaries represented on the published maps, but

unfortunately the data are not enough to allow new boundaries to be established with any certainty. A comparison of the accompanying with the published geological maps, both upon one scale, will not only show how much re-arrangement will be necessary, but incidentally will illustrate how greatly our knowledge of the topography of that region has advanced since the geological maps were published. Probably the granites and schists will be found to be intermingled in a very complicated manner. The granites are undoubtedly, as our geologists agree, intrusive, and the schists are the result of the action of the granites upon the sedimentary rocks into which they were intruded.

The original data for the location of the boundaries on the geological map may be found in the reports of Hind and of Ells, the only professional geologists who have been within this area,* while the additional data for the accompanying map are in the preceding notes of this series at the pages noted below. Hind, in 1864, crossed from Long Lake to Big Lake, visited its outlet and returned to Long Lake. Ells, in 1880, ascended the Little Southwest Miramichi to about the mouth of the Walkemik or Upper North Branch (as he tells me in a letter) and returned by the same route.

GRANITES. On the Little Southwest, near Indian Brook, by Ells, in 1880 (Report, 1879-80, D, 34). I have myself seen these ledges which contain inclusions of schist. Near McInnes Lake and at Wigwam Pond in Note 63, page 67. On Milnagek Lake, Note 56, page 470. Above Senda Lake, below Gover Lake, and on lower course of Walkemik, in Note 87, page 341. On Renous, Note 85, page 316.

SCHISTS. At the outlet of Tuadook Lake by Hind in 1864 (Report, 1865, page 153). On Upper Graham Plains, Note 64, page 75. Northeast of the Crooked Deadwater, Note 55, page 465. On the Renous Lake and River, Note 85, page 314, 316. On stream near Crooked Deadwater, Note 86, page 326. On branch of Patchel Brook and lower course of Walkemik Branch, Note 87, page 341.

My note on Patchel Brook (Note 64, pages 73, 75) speaks of both felsites and granites forming the walls of the gorge of that stream, but I am uncertain as to their extent and mutual relations.

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* Edward Jack, an amateur geologist, was in this vicinity in 1873, and, apparently, earlier, and made some observations, finding, however, no ledges within the area of our map. Charles Robb concluded erroneously from from Mr. Jack's notes that all this area was occupied by granite. (Report of the Geological Survey, 1870-72, page 251).

## ARTICLE II.

# THE PHYSIOGRAPHY OF GRAND LAKE.

By W. S. Butler.

Read 7th February, 1905.

(ABSTRACT)

Grand Lake is the largest sheet of fresh water in New Brunswick, and is part of a group of lakes on the eastern side of the valley of the St. John, in the flat region where it is bordered by extensive intervals or alluvial flats. It is connected with the other lakes by a thoroughfare or narrow creek-like passage, and connected with the St. John river by a narrow, tortuous passage called the "Jemseg." The lake is about twenty-five miles long, and from three to five miles wide, and has some long bays extending to the north-eastward. Salmon river, the principal affluent, enters the lake close to its upper end and with several important branches, conveys to it a large volume of water. The river next in size that enters the lake is Newcastle river, on which are important coal mines. Douglas Harbor, on the north-west side of the lake, formerly called the "Keyhole" is a remarkable indentation ; it has high banks around it, but no stream entering it. Long point, on the same side of the lake is dangerous to navigation, because from it runs out a long bar, just under water, and so concealed from the navigator. The lake is comparatively shallow, especially in its upper part, between Bear island (concerning which the writer sent a communication to the society some years ago) and the head of the lake. There are extensive farming lands around this lake, especially along its south-eastern and western shores, with rolling lands and fertile fields. The northern shores of the lake are flatter and lower, and the lands there have supplied much lumber for market, at present the soft wood used for lumber is mostly cut away, but much hardwood remains. Formerly large vessels were built around Grand lake, but now the construction of vessels is confined to wood-boats and schooners. In the spring of the year there are excellent fisheries for gaspereau and shad in Grand lake and the lakes connected with it. Large numbers of wild fowl are found in its marshes and afford much sport in the autumn.

# ARTICLE III.

## ON AN EARTHENWARE POT OF THE STONE AGE FOUND AT MAQUAPIT LAKE.

BY G. F. MATTHEW AND S. W. KAIN.

Read Dec. 6, 1904.

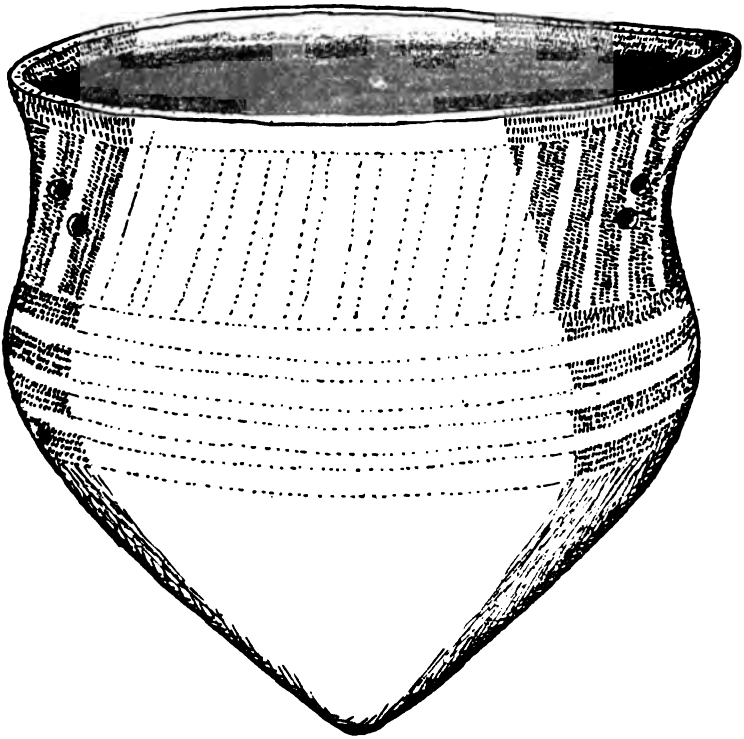

Fig. 1.— RESTORATION OF EARTHEN POT — ⅓ ORIGINAL SIZE.

In the autumn of this year the Society received from Mr. Duncan London portions of an ancient stone pot, which was obtained from him by correspondence with one of the authors of this paper.

This donation is of unusual interest, as the remains of the pot are sufficiently complete to enable us to reconstruct a typical piece of the pottery used by the people of the Stone Age who inhabited the valley of the St. John river before the advent of Europeans.

Heretofore we have had only small fragments of pots, etc., which may have belonged, as regards the several finds, to one vessel, or to many; and so doubt and uncertainty existed as to the size and form of the vessels to which these fragments belonged.

With Mr. London's fragments of a single pot, we are able to reconstruct the vessel from the bottom up to the lip, and observe the pattern which the ancient potter traced on the surface of the vessel, and judge of the amount of artistic skill displayed in its ornamentation.

Further, with this pot as a standard, we can study to advantage the numerous pieces of ancient pottery of the Stone Age in the Society's possession, and to note any difference that may exist in form and ornament between it and others from the same district, and from other parts of the province. From these comparisons we hope to form some opinion of the possibility of these earthenware fragments belonging to successive inhabitants of this region, or to different tribes inhabiting parts of the province, or adjacent regions. Where a people have left no written records, we are thrown back upon such methods as these, for obtaining a knowledge of their domestic habits, and stage of advancement in the arts of civilization; which is of more importance to humanity than a record of their wars and conquests.

Since the visit of our Society to French Lake in 1893, when we held a summer camp there, and made a study of the natural features and archæology of the district,* Mr. London, who lives near there, has taken a great interest in the remains left by the Stone Age people, and has been in frequent correspondence with one of the authors of this paper. More than once he has shown his liberality by giving to our museum articles of this nature which he has secured around French and Maquapit Lakes.

The remains of this pot were found by Mr. London in the

N. H. S. Bulletin No. XII, p. 84.

edge of Maquapit Lake, at a time in the summer when the waters of the lake were unusually low, and so exposed portions of the flats on the S. W. shore of that lake which usually are under water. Along this side of the lake are remains of an abandoned portion of the thoroughfare from French Lake, now partly silted up. This thoroughfare now goes directly out into Maquapit Lake, west of the old deserted channel. The subsidence of the earth's crust in this part of the valley of the St. John river would have allowed this to occur, by the depression of the portion of the intervale which once protected this abandoned channel from the surf of the lakes.

It is quite possible that the subsidence of this area by bringing the spot where the pot was found, beneath the ordinary lake level at the present day, may have been the means of preserving it from the destruction by frost which has overtaken other vessels that have been exposed to its action, when lost in the water or abandoned at higher levels along the lake shores, and thoroughfares.

The form of the pot donated by Mr. London is not without special significance. Heretofore, from the fragments preserved we have thought the bottoms of pots of people of the Stone Age in this region were round; such a form would have a special advantage where the vessel was not used to set on a flat surface, but to be held in a bed in the ashes, or the loose earthen floor of a hut bottom. But in Mr. London's pot there is a departure from this ideal, in that the form of the bottom is that of a rounded cone; this conical shape would have an advantage, where the bottom of the pot was set in the ashes of the fire; it would rise the body of the pot higher than if the bottom were round, and so bringing its sides more completely under the action of the fire.

That the pot was not raised entirely above the fire, as the ordinary iron pot now in use is, seems clear from the fact that the surface coating of clay at and near the bottom, is not burned off, as it is higher up on the slope of the pot.

The outward slope of the pot rises to about the middle, whence it curves gradually inward, so that the upper third of the pot has a smaller diameter than the middle; and above this constricted

portion it slopes outward again to the lip. This curving form is not only pleasing to the eye, but protects the upper part, where the ware is thinner, from the fierce action of the fire.

We had observed this curving slope in fragments of aboriginal pottery previously collected, and in the first field camp which the Society held, viz., the one at Bocabec (1883),* an implement of bone was collected which puzzled the members who worked at the shell heaps of the Stone Age that are found there, as to its use or purpose. The object was sent to Sir Daniel Wilson, then the chief Canadian expert in archæology, who stated that this tool was believed to have been used in forming the curve, which is found below the rim in these ancient culinary vessels.

The material of which this pot was made appears to have been ordinary fine river sand mixed with clay. Where the force of the fire in subsequent use has been strong enough to change the color of the pot, the iron in the clay has been sufficient to give the ware a brown tint. Elsewhere it remains of a gray color, showing that in the original firing it was not subject to intense heat, such as is used in the manufacture of modern pottery; it is, therefore, at present tender and easily broken. Also for this reason it is not easy to attach broken fragments that evidently belong together, and the reconstruction of a pot becomes difficult.

With such tender ware it was necessary to make up in thickness what is lacking in cohesive strength, and so the bottom of the pot was made quite thick. At the apex (in the bottom of the pot) it is 1½ inches thick; at three inches from the bottom it is ¾ of an inch thick, and at six inches up it is ½ an inch thick; a little above this it is ⅜; and from this to the lip varies from ⅜ to ¼ of an inch in thickness. Thus the greater thickness of the pot is from the widest part down to the apex, increasing gradually, while the upper half of the pot is comparatively uniform in thickness.

While the outside of the pot (leaving out the pattern on the surface) was quite smooth, the inside shows marks of the potter's hand. These are impressions of the ends of the fingers drawn around the pot to form it. These impressions are not quite

* N. H. S. Bulletin No. III, p. 7.

regular, as we would expect them to be, if a potter's wheel had been used in forming the pot; but in some places the finger streaks are deeper, and in others less marked.

The outer surface of the pot, where not worn or cut by the fire, is remarkably smooth, much more so than the inside. It evidently had a luting of fine mud or clay spread over the whole outer surface, and upon this sensitive coating the pattern was laid. How the very smooth surface was given to this luting of clay we can only conjecture; but we may surmise that a brush of fine fur would serve as a tool for this purpose.

For about 3½ inches from the apex the surface of the pot is perfectly smooth; this is the part that would be buried in the ashes when the pot was in use.

The pattern (which we may call rush pattern) on the lower part of the pot, above the smooth surfaces, consists of faintly impressed longitudinal grooves, radiating from the bottom up the slope of the vessel. We conjecture that this pattern may have been impressed in the following way: To support the pot at a level, where the potter could work at it conveniently and without detriment to the smooth surface, the vessel may have been held in a hoop, supported at the sides on stakes; if this hoop had a lining of rushes held in place at the top by another hoop (making a double hoop), and these rushes were tied together at the bottom, they would form a bag or cavity in which the pot could be placed preparatory to using the tool by which the chief pattern made on the surface of the pot was given. The weight of the pot itself was sufficient to cause the faint longitudinal grooves which we find near its lower part. This part of the pot was about three inches wide.

Above the Rush pattern we come to the part where the potter applied herself seriously to the decoration of the surface. From here up to the lip of the pot, we find the ornamentation made with one and the same tool, and a similar tool has been used in the decoration of the other fragments of pottery of the Stone Age found in New Brunswick.* The pattern on this pot is such a one as might have been made by a row of four or five projections

* See Bulletin Nat. Hist. Soc. of N. B. No. III, p. 17.

similar to the small teeth.* A modern artizan would have set such tools in a small wheel to facilitate rapidity of work, but we have found no proof that such a device was used on the aboriginal pottery of New Brunswick. If the tool were a chisel-ended one with teeth, the resulting ornament does credit to the infinite patience of the potter who decorated the surface of this pot, for only a steady hand and great care could have made the separate indents so uniform as they are seen to be. On the other hand, the several rows of pattern are by no means exactly spaced from each other, as some are even twice as far apart as others.

FIG. 2.—DECORATION ON THE POT.—NATURAL SIZE

The pattern made by the tool above indicated consists of a central depressed furrow, with faint tooth-like impressions or dots; on one side of this (the right hand)† they are more distinctly like a pair of tooth marks, with a shallow line between the two teeth; or the other (the left) there are similar toothed impressions, but the division of the two teeth is less marked. There are thus two little teeth on one side of the median depression, and a single long tooth impression (or one obscurely divided in two) on the other. When well preserved, the median groove is also seen to have faint tooth-like impressions in the bottom. The

*See Bulletin Nat. His. Soc. of N B. No. III, p. 17.

†In this figure the pattern is reversed.

whole width of this tooth pattern is about half of an inch, and bands thus made run over the surface of the pot.

In the laying on of the pattern for a space of about three inches around the bilge of the pot there are four horizontal rows of these bands (See Fig. 1), and in some places they are nearly obliterated, being worn off by the fierce action of the fire; but it can be seen that the tool which made this pattern even pressed through the clay coating and indented the sandy bottom of the ware, so that both the ware itself and the fine luting that covered it must have been in a plastic condition when the tool was applied.

Above the bilge, where the sides of the pot are concave, for a space of about three inches in width, the surface is marked by bands of pattern, which in place of being horizontal, as those below, are diagonal; these extend nearly to the lip of the pot. (See Fig. 1). Here the pattern is in better preservation, having escaped somewhat the intensity of the fire. These bands of pattern start from the uppermost of the four horizontal bands.

Finally there is a horizontal row of tooth-like impressions around the brim below its edge. These have been made by a different tool from that which made the diagonal pattern below; they show three or four more deeply indented teeth, but are intended to carry out a similar design. In this row there are about eight or nine imprints in the space of an inch, but in the main pattern twice that number. The upper edge of the pot has a row of two teeth all around, as there is not room to show the full pattern. But inside the brim is a row of three or four tooth pattern intended to carry the same ornamentation over the rim.

The transverse diameter of this pot was nearly one foot, and the height of the pot somewhat less. The mouth of the pot is not perfectly round, for a deviation from the circular outline of the edge is caused by a short lip where the edge is pushed or drawn out for convenience in pouring out the contents of the vessel. (See Fig. 1). The spout is a short, broad one, but resembles those we have seen on some modern pitchers. That the projecting lip has been used for this

purpose is clear from the blackened outer surface of the pot below this spout, showing where the drippings of the pottage has been charred by subsequent use of the pot on the fire.

And indeed we found evidence here, as the explorers at Bocabec had at an earlier date, that the cook did not exercise much care in cleansing the inside of the pot after use, as this in places bore evidence in a charred crust that no trouble was taken to clean the inside of the vessel.

One peculiar feature that marks this pot is the presence of holes bored through the ware from the outside, and quite fresh in appearance, as though not worn from use. These holes are from an eighth to a quarter of an inch in diameter, and are in pairs in the hollow or curved part of the pot, about an inch and a half, below the brim. There are two pairs, one on each side of the spout, and there is another pair in the back part of the pot, but exactly where does not appear from the fragments preserved; possibly there may have been another pair of paired holes at the back to correspond to those near the spout. These paired holes are not in a horizontal position, but in each pair one is considerably below the other.

Similar paired holes have been found in aboriginal pottery found in Ontario, and Mr. David Boyle has suggested that they were made to fasten two pieces of pottery together, *i. e.*, to repair a break. But this cannot be the case with the holes in the pot from Maquapit Lake, for in it there are no breaks between the holes. It has been thought that these holes were for strings or sinews by which the pot could be suspended or lifted, and Mr. Boyle has suggested that these strings could be protected from the fire by a covering of clay plaster on the outside of the pot; but in the Maquapit pot we find no trace of such material having been used over these holes as a shield from the fire.

What makes the purpose and use of these holes all the more difficult to understand, is that a single hole somewhat larger than the others was bored at a point which is even below the fullest part of the bilge of the pot, where, unless plugged, it would have drained off the principal part of the contents of the pot. It would seem possible that this pot, after it had served its purpose

as a cooking vessel, may have been used for the storage of small valuables of a family of the Stone Age people, and that the perforations were for strings with which to suspend the vessel in some out-of-the-way corner of the hut. Or it may be that these people were migratory in their habits, like the present aborigines, and buried their valuables when moving to a new camping ground. (See paragraph in Mr. London's letter relative to the depths at which pottery fragments were found).

We append here copies of the letters received from Mr. London and Mr. Boyle relative to this vessel:

LAKEVILLE CORNER, Sunbury Co.
November 14th, 1904.

DEAR MR. KAIN:

I accept with much gratitude the hearty vote of thanks tendered me by the Natural History Society, and only wish that I could render better assistance in the good work that is being done. I am always encouraged by the attention which you and Dr. Matthew give to specimens that I send you.

On Monday, August 8th, 1904, I was prospecting for Indian relics at Ring's Island, S. W. side of Maquapit Lake, and soon discovered on the point of the ridge, about two or three rods from the bank of the thoroughfare, a large lump of mud of a little lighter color than the mud-flat, and as I had found two other objects like it this year, and two last year, in the same place, I knew that I would find pottery fragments under it, and I secured what was left of the largest and thickest pot I have ever seen, and have just sent you the same. All the other fragments I got there this year and last I did not keep separate. There were not enough pieces together of any other dish to indicate how large it was. All that are not yet uncovered are probably more or less broken. When the water is summer-low the ridge is about six feet out. The pot I sent you had been about one foot under ground. Of the other four, one was at the surface of the ridge. The depth of the rest under ground had been six, twenty-four, and thirty inches, respectively.

I am sending you a sketch of Maquapit Lake, showing the above-mentioned place.

Yours sincerely,
DUNCAN LONDON.

P. S.—Those pots were from ten to twenty-five feet apart. You can make what use you please of this note.

TORONTO, November 16th, 1904.

SAMUEL W. KAIN, ESQ., Custom House,
St. John, N. B.

DEAR SIR:

In reply to your letter of the 14th inst., in which you refer to the fact that certain portions of the old Indian pot found in New Brunswick are perforated and look as if rimmed, or countersunk from the outside, I remember very distinctly the conversation you and I had on this subject in our museum, and I remember equally well telling you that, as far as I knew, I was the first to offer, what I regard, as being the only explanation that satisfies the conditions, so far as such holes are concerned. You say that Dr. Matthew offers an objection respecting my theory, asking, "What material could have been used to do the fastening which would stand fire?" This is an easily answered question. In the first place, I do not think pots of this kind were ever placed *over* the fire. They were placed *beside* the fire, and heated stones from the fire were placed in the pots. But even where we may suppose the pots to have been placed on the fire, you know as well as I do, that on account of the rounded bottoms of all our Canadian pottery, the vessels were first steadied in a hollow in the ground, around which, we have reason to believe, the fire was sometimes placed. In such a case, if the perforations are found in the bottom, any binding material would be safe there from the fire. If used on the sides, they would be safe when plastered over with clay, and in any event, there is little doubt that clay *was* plastered over the cracks that the holes were made to bind together. Of course not being able to see the holes for myself, or to knowtheir exact position in the pot, I am unable to say how far the conditions will square with my theory. I have, however, little doubt that it was for the purpose I have mentioned these holes were made. If, as Dr. Matthew thinks, such holes were made for the purpose of tipping the pot, or, as still others think, for the purpose of having something to use as a handle or bail, it occurs to me that holes for such purposes would have been made by the potter when she was modelling the vessel.

Can you not send me a drawing of that pot, even if it be only a rough sketch? From what you say about holes being rimmed from the outside, this rimming or countersinking is proof that the holes were made after the pot was finished. Are these holes on each side of a fracture?

Yours respectfully,

DAVID BOYLE.

ARTICLE IV.

# SUPPLEMENTARY LIST OF THE LEPIDOPTERA OF NEW BRUNSWICK.

BY WILLIAM McINTOSH.

In Bulletins Nos. XVII, XVIII and XIX, introductory lists of the Lepidoptera of New Brunswick are given. These lists enumerate some 53 species of butterflies and 232 moths. The moths include only the super-families Sphingoidæ, Saturnoidæ and part of the Bombycoidæ of Dyar's catalogue.

The following list is presented as a supplement to those already published. The species enumerated belonging to the families represented in the lists found in the Bulletins named above.

### *FAMILY NYMPHALIDÆ.*

Polygonia satyrus, Edw. This is considered a western species, but our specimens have been examined by Dr. Fletcher and pronounced genuine satyrus. Rare; only a few specimens have been taken.

### *FAMILY AGAPETIDÆ.*

Enodia portlandia, Fab. Two specimens of this rare butterfly were taken during the past summer about twenty-two miles above Fredericton by Stanley Jewett.

### *FAMILY LYCÆNIDÆ.*

Thecla acadica, Edw. Evidently rare, taken at Scotch Lake, Queens Co., by William H. Moore, and at Nerepis, Kings Co., by the writer.

### *FAMILY HESPERIIDÆ.*

Amblyscirtes samoset, Scud. A few specimens taken in July. May be fairly abundant, but owing to its quick flight, small size, and dark color, is not easily noticed.

### *FAMILY SPHINGIDÆ.*

Phlegethontius cingulata, Fab. Occasionally abundant late in the summer.

Ceratomia amyntor, Geyer. Not a common species.

Lapara bombycoides, Walk. Not common, June.

## *FAMILY SATURNIIDÆ.*

Automeris io, Fab. Not uncommon in Western New Brunswick, but we have no record of its occurrence near St. John.

## *FAMILY ARCTIIDÆ.*

Eubaphe aurantica, var. rubicundaria, Hbn. Rare.
Eubaphe aurantica, var. quinaria, Grt. July, not abundant.
Arctia caia, Linn. This moth is taken in Western New Brunswick. We have no record of its occurrence near St. John.
Halisidota caryæ, Harr. Taken in York and Carleton Counties.

## *FAMILY NOCTUIDÆ.*

Panthea furcilla, Pack. Rare, July 15 to 31.
Apatela funeralis, Grt. Two specimens in July.
A. grisea, Wlk. Rare, late in June and July.
A. brumosa, Gn. One specimen, May 31.
A. hæsitata, Grt. One specimen, August 12.
A. sperata, Grt. Rare, July 2 to 5.
A. noctivaga, Grt. One specimen, June 15.
A. distans, Grt. Not common.
A. lanceolaria, Grt. Recorded from Chatham.
Arsilonche albovenosa, Goeze. Not common, June, July and August.
Dipthera fallax, H. S. Occurs in August.
Hadena mactata, Gn. Two specimens.
H. ducta, Grt. One specimen.
H. lignicolor, Gn. Rare.
Feralia jocosa, Gn. Not common, taken last of May.
Pyrophila pyramidoides, Gn. One or two records from Central New Brunswick.
Oncocnemis artifasciata, Morr. Not common in August and September.
Eueretagrotis attenta, Grt. Common July 22 to August 17.
Semiophora elimata, Gn. Common in July.
Pachnobia fishii, Grt. Occasionally very abundant in May.
Noctua oblata, Morr. A few specimens in July.
Carneades detersa, Walk. This species appeared in the list published in Bulletin XVIII as Carneades quadridentata, on the authority of the late Dr. Strecker. Prof. John B. Smith, upon examining a series of specimens from this locality, found it to be Walker's Charæas detersa, our specimens being larger and much darker than the American specimens accounting for Dr. Strecker's mistake.
Mamestra grandis, Bdv. Reported from Chatham.
M. rosea, Harv. Several taken in June.

M. rugosa, Morr. One specimen, July 9.
Orthodes crenulata, Butler. A common species.
Xylina tepida, Grt. Taken in some numbers in April.
Litholomia napæa, Morr. A common species in April and May.
Calocampa cineritia, Grt. Not common, June.
Achatodes zeae, Harr. One or two specimens only.
Papaipema purpurifascia, G. & R. Rare.
P. rutila, Gn. Not common.
Tapinostola variana, Morr. One specimen, July 14.
Euchalcia venusta, Wlk. One specimen. August 7.
Eosphoropteryx thyatirodes, Gn. Two specimens taken in August.
Autographa rubidus, Ottol. Dr. Ottolengui described this species in 1902 from New Brunswick and Manitoba specimens.
A. alias, Ottol. A very common moth.
A. vaccinii, Hy. Edw. Common.
A. variana, Ottol. Described by Dr. Ottolengui from a species taken by the writer. New Brunswick is the only known habitat for this species.
Erastria carneola, Gn. One specimen, July 15.
Euclidia cuspidea, Hbn. Rare, June.
Syneda alleni, Grt. Not uncommon in June and July.
Zale horrida, Hbn. One specimen.
Thysania zenobia, Cram. This South American moth was taken near St. John in 1902. This being the first record of its occurrence in Canada.
Epizeuxis lubricalis, Geyer. Common.
Palthis angulalis, Hbn. Very common.
Lomanaltes eductalis, Wlk. Common.
Bomolocha baltimoralis, Gn. Also abundant.

## *FAMILY NOTODONTIDÆ.*

Melalopha apicalis, Walk. Several taken.
Melalopha albosigma, Fitch. Not common, June.
Gluphisia septentrionalis, Walk. Not common, June.

## *FAMILY LIPARIDÆ.*

Euproctis chrysorrhœa Linn. One specimen taken. This was the first Canadian record of the brown tail moth. The writer has not been able to visit the locality of its capture since to see if additional specimens could be found.

## *FAMILY LASIOCAMPIDÆ.*

Tolype velleda, Stoll. Two specimens taken at McAdam Junction.

# ADDITIONS TO THE PLANTS OF NEW BRUNSWICK.

By G. U. Hay, Chairman Botanical Committee.

During the past two seasons about forty species and varieties of flowering plants new to New Brunswick have been reported, while additional new localities have been found for a number that have been hitherto considered rare.

In the latter part of June last, Mr. M. L. Fernald, of the Gray Herbarium, Cambridge, Mass., spent a day in St. John, part of which was devoted to an examination of plants on the Ballast Wharf. In the afternoon of the same day, with two members of our Botanical Committee, some hours were spent in Rockwood Park investigating the plants. In both places the investigation proved of considerable interest, and a few new varieties were added to our list of introduced plants.

A week later I had the great pleasure of meeting with the Josselyn Botanical Society of Maine at Fort Kent. Nearly a week was spent in examining the flora of the meadows and forests on both sides of the St. John river in that vicinity. Several plants new to New Brunswick were found, which are recorded in the list following, and a few are recorded separately, which were found on the Maine side of the boundary. These are to be looked for in New Brunswick, where their occurrence is probable. Mr. Fernald's exact knowledge of the plants of that region proved of the greatest service to the other botanists of the party, and especially to the New Brunswick representative. Indeed, the members of the Josselyn Club were all very generous in extending their investigations into this province, and both sides of the river came in for a fair share of attention, a kind of pleasant and unselfish reciprocity which might be more widely imitated in the relations between the two countries.

The botanists of the Atlantic Provinces of Canada — New Brunswick, Nova Scotia, Prince Edward Island, and Eastern Quebec — might well form a society like the Josselyn Botanical

Society of Maine to investigate more fully the flora of these provinces, which has so much in common and at the same time such marked differences. A society like this, spending a week or more every season, alternately inland and near the seashore, would do much in the interests of botanical research for these provinces.

The presence of the members of the Royal Society and its branch—the Botanical Club of Canada—in this city in June last was another occurrence of interest. The members of the club enjoyed an outing in the Park, and other points, and the presence of Dr. Jas. Fletcher, Dr. A. H. MacKay and others contributed to the success of the meeting.

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## SOME NEW AND RARE PLANTS.

The following embrace the discoveries of the past two years. The names of those plants printed in full face type are recorded for the first time in New Brunswick.

16 Ranunculus sceleratus, L. Dalhousie. *Fernald.*

41 Barbarea vulgaris, R. Br. Ballast Wharf, St. John. *Fernald* and *Hay.*

49*a* **Sisymbrium altissimum,** L. On railway track near Ingleside. A newly imported weed. *Dr. Jas. Fletcher* and *G. U. Hay.*

50 Erysimum cheiranthoides, L. On railway track near Ingleside. *Hay.*

58*a* **Lepidium apetalum,** Willd. Ballast, St. John. *Fernald.*

68*a* **Viola septentrionalis,** Greene. Woods, St. John. *Fernald.*

105*a* **Hypericum boreale,** Bicknell. Bathurst. *Fernald.*

179*a* **Pyrus sitchensis,** Piper (=P. sambucifolia of eastern authors) In Rockwood Park, St. John. *Fernald* and *Brittain.*

180 Potentilla simplex (=Protentilla canadensis, L., var. simplex, Torr. and Gray. On grassy bank near Ballast Wharf, St. John. *Fernald* and *Hay.*

244*a* **Osmorrhiza divaricata,** Nutt. St. Francis, Madawaska Co. *C. H. Knowlton.*

280*b* **Galium Claytoni,** Michx. Bathurst. *Fernald.*

280*c* **G. labradoricum,** Wiegand. St. John. *Fernald.*

280*d* **G. palustre,** L. Bathurst. *Fernald.*

310*b* Aster longifolius, Lam. Ingleside. *Hay.*

316*a* **A. subulatus,** Michx. Salt Marsh, Bathurst *Fernald.*

323*a* **Antennaria canadensis,** Greene. Bathurst. *Fernald.*

323*b* **A. neodioica,** Greene. Bathurst. *Fernald.*

343*a* **Matricaria discoidea,** D.C. Ballast Wharf, St. John. *Fernald* and *Hay.*

343*b* **M. inodora,** L. St. John and Bathurst. *Fernald.*

354*a* **Senecio sylvaticus,** L. St. John. *Fernald.*

355*b* **S. Robbinsii,** Oakes. Along railway track near Harvey Station. *Fernald.*

366*a* **Hieracium floribundum,** Wimm. & Grab. St. John. *Fernald.*

367*a* Leontodon autumnalis, L., var. **pratensis,** *Koch.* Near Ballast Wharf, St. John. *Fernald.*

368*a* Taraxacum officinale, Weber, var. **palustre,** Blytt. St. John. *Fernald* and *Hay.*

392 Vaccinium caespitosum, Mich. Dry grounds. St. Francis, Madawaska County. *Hay.*

399 Epigaea repens, L. In fruit (rarely found). Fort Kent. *Fernald.*

413 Monotropa hypopitys, L. In moss of fir woods. Ingleside. *Hay.*

422*a* Glaux maritima, L., var. **obtusifolia,** Fernald. Bathurst, *Fernald.*

461. Limosella aquatica, L., var tenuifolia, Hoffm. Bathurst. *Fernald.*

466*a* Veronica serpyllifolia, L., var. **borealis,** Laestadius. Thickets on banks. St. John River. Clair, Madawaska County. *Members Joss. Bot. Soc.*

527*a* **Polygonum exsertum,** Small. Salt marsh, Bathurst. *Fernald.*

541*a* **Rumex Acetosa,** L. Fills some fields between St. John and Coldbrook. *Fernald.*

567*a* **Betula glandulosa,** Michx. On the big plateaus along the South Branch Nepisiguit. *W. F. Ganong.*

582*a* Salix glaucophylla, Bebb. Gravelly shores of Upper St. John. St. Francis. *Members Joss. Bot. Soc.*

582*b* Salix lucida, Muhl., var. **intonsa,** Fernald. Along Upper St. John River St. Francis. *Members Joss. Bot. Soc.*

584*a* S. **alba,** L., var. **vitellina,** Koch. Rockwood Park, St. John. *Fernald* and *Hay.*

600 Picea nigra, Link. The slender ragged-topped spruce of our northern swamps. *Fide Fernald.*

620 Pogonia ophioglossoides, Nutt. St. Francis. *Members Joss. Bot Soc.*

622*a* **Habenaria virescens,** Spreng. Low wet places along the Northwest Branch Oromocto river. *Ganong* and *Hay.*

623 H. bracteata, R. Br. (=H. viridis, R. Br., var. bracteata, Reichenbach). Wet meadows and woods. Oromocto and St. Francis. *Hay.*

630 H. lacera, R. Br. Moist thickets and meadows. Ingleside. *Hay.*

632 H. fimbriata, R. Br. Moist thickets. Ingleside. Second station reported in New Brunswick. A handsome plant with large lilac-purple flowers. *Hay.*

637*a* **Iris setosa,** Pallas, var. **canadensis,** Foster. Abundant on beaches and headlands of the Bay Chaleur. *Fernald.*

638*a* **Sisyrinchium angustifolium,** Mill. On grassy bank near Ballast Wharf, St. John. *Fernald* and *Hay.*

672*a* **Juncus alpinus,** Vill. Bathurst. *Fernald.*

677*a* Luzula campestris, D.C., var. **frigida,** Buchenan. On grassy banks near Ballast Wharf, St. John. *Fernald* and *Hay.*

732 Scirpus rufus, Schrad. Bathurst. *Fernald.*

753*b* Carex canescens, L., var. **disjuncta,** Fernald. Bog in Rockwood Park, St. John. *Fernald* and *Brittain.*

786*a* C. umbellata, Schk., var. **brevirostra.** Boott. Alluvial thicket, banks of the St. John, at Clair, Madawaska County. *Fernald* and *Collins.*

817*a* **C. glareosa,** Wahl. In brackish places, clefts. Dalhousie, Restigouche County. *M. L. Fernald.*

817*b* **C. albicans,** Willd. In alluvial thicket on banks of St. John, at Clair, Madawaska Co. *Fernald* and *Collins.*

829*a* **Panicum boreale,** Nash. Alluvial thicket, banks of the St. John, at Clair, Madawaska Co. *Fernald* and *Hay.*

833 Hierochloe borealis, Roem and Schultes. Clair, Madawaska County. *Hay.*

864 Poa pratensis, L. Waste grounds. St. John. *Fernald* and *Hay.*

864*a* P. pratensis, L., var. **domestica,** Laestadius. Waste grounds, St. John. *Fernald* and *Hay.*

864*b* **P. glauca,** Vahl. In alluvial soil, banks St. John river, Clair, Madawaska Co. *Members Joss. Bot. Soc.*

876*a* Glyceria borealis, F. W. Batchelder. Banks of St. John, at Clair, Madawaska County. *Fernald* and *Hay.* Second station reported in New Brunswick.

892*a* Equisetum arvense, L., var. **campestre,** Milde. Gravelly shores of the St. John, at St. Francis. *Members Joss. Bot. Soc.*

The following plants found by Mr. M. L. Fernald on the borders of New Brunswick may be looked for within the province: *Poa alpina,* L., on rocks, Metapedia side of Restigouche; *Osmorrhiza obtusa,* Fernald (a cascade mountain plant) found on the Restigouche at the mouth of the Metapedia, should occur on the New Brunswick side; *Cnicus discolor,* Gray, a large plant, 4-6 feet high, leaves white underneath, at Van Buren and on Aroostook river, Maine; *Listera auriculata,* Wiegande, *Carex Crawfordii,* Fernald, *Carex Raeana,* Boott (very rare), *Lycopodium sitchense,* Rupr., found at or near Fort Kent, Maine.

## ADDITIONS TO NEW BRUNSWICK FUNGI.

The following additions have been made to the list of New Brunswick larger fungi. They have all been collected at Ingleside, except where mention to the contrary is made. The same plan has been adopted as in previous lists of subjecting all critical species to the notice of a specialist. Dr. W. G. Farlow, of Cambridge, Mass., Professor G. F. Atkinson, of Ithaca, N. Y., and Professor C. H. Peck, of Albany, N. Y., have kindly examined and identified many of the plants found in the list following:

Amanita spreta Pk. Ground in open places. Poisonous.

A. rubescens Pers. Edge of woods.

Lepiota naucina Fr. Growing in conservatory of H. E. Gould, Sussex.

L. carcharius Fr. In open places.

Armillaria imperialis Fr., var. americana Farlow. A fine specimen, growing under evergreens.

A. imperialis Fr., var. grisea Farlow. "This is the specimen noted as *A. imperialis* (?) Pk., in Bulletin No. 21. Found in a few places in New Brunswick and Maine. Distinguished from A. ponderosa by the double ring. The American specimens do not differ from the European species, except in the paler color of the pileus. A similar variation in color is found in other species of this genus, and the New Brunswick fungus may be called A. imperialis Fr., var. grisea Farlow."—W. G. F.

Clitocybe laccata Scop., var. striatula Pk. In mixed woods and open places.

Collybia longipes Bull. Deeply rooted among decaying deciduous leaves.

C. fusipes Bull. On decayed wood.

C. radicata Rehl. Among decayed leaves in deciduous woods.

Mycena leaiana Atkinson. On rotting leaves.

Lactarius torminosus Fr. Low woods. Acrid white juice. Said to be poisonous.

L. resimus? Fr. Common in the woods about Ingleside.

L. uvidus Fr. In woods. The milky juice white, turning as also the flesh to a beautiful lilac.

Russula punctata Gillet. In grassy places.

R. rubra Fr. In mixed woods.

Cantharellus infundibuliformis Fr. In mossy damp woods.

C. rosellus Pk. In the moss of thick evergreen woods. A pretty plant.

Flammula sapinea Fr. Growing on dead coniferous wood.

Cortinarius purpurascens Fr. In mixed woods.

C. albo-violaceus Pers. In open woods.

C. asper Pk. In woods and clearings.

C. lilacinus Pk. Low mossy grounds in woods.

C. castaneus Bull. On the ground in spruce woods.

C. ochroleucus (Schaeff) Fr. On the ground among decaying leaves.

C. sanguineus Fr. Under and upon moss-grown decayed logs. Whole plant a dark blood-red color.

Paxillus strigosus Pk. In mixed woods.

Gomphidius glutinosus (Schaeff) Fr. On borders of evergreen woods. An interesting co-partnership was noted,—the base of the stem of this plant united to that of a boletus.

Lentinus cochleatus Fr. Found on stumps.

Boletus albus Pk. In evergreen woods.

B. edulis Bull., var. clavipes Pk. Everywhere in mixed woods.

B. vermiculosus Pk. In woods. The plant changes suddenly to a beautiful blue when wounded.

B. ornatipes Pk. Woods and open places.

B. serotinus Frost. Shaded grassy places. Flesh white, changing to a bluish color when wounded.

B. subtomentosus L. In woods.

Boletinus porosus (Berk) Pk. Damp grounds in woods and open places.

B. pictus Pk. In the moss of woods and swamps.

Polyporus varius Fr. On stumps.

P. circinatus Fr. Somewhat rare. A fine specimen, with duplicate strata of pilei, found growing on the roots of an upturned fir tree.

P. leucophaeus Mont. Growing on dead trunks.

P. fomentarius Fr. A small form found on oaks.

Poria tomentocincta B. & Ray. On dead wood.

Daedala unicolor Fr. On stumps, especially birch.

Merulius tremellosus Schrad. On decayed trees. Rare.

Hydnum ochraceum Pers. On dead branches.

Hydnum albonigrum Pk. In evergreen woods.

Sistotrema confluens Pers. Rare. On the ground and on stumps.

Radulum Bennettii B. & C. *Fide* G. F. A. On dead trunks.

Phlebia merismoides Fr. On stumps and branches. Rare.

Craterellus clavatus Fr. On the ground in the moss of swamps.

C. cornucopioides Pk. In woods. Not common.

Geoglossum glutinosum Pers. On the ground among grass, etc.

Peziza scutellata. On decayed wood.

Xylaria polymorpha. On dead trees.

| | |
|---|---|
| Plants previously reported,. . . . . . . . . . . . . . . . . . | 233 |
| Additions named above, . . . . . . . . . . . . . . . . . . . . | 53 |
| Total, . . . . . . . . . . . . . . . . | 286 |

## OBSERVATION OF PLANTS, 1904.

By G. U. Hay.

*April* 30.—A very severe winter with abundance of snow and steady cold weather. Sleighing good up to the end of March. April has been cold, with hard frosts and frequent light falls of snow up to the 20th. On the 19th there was a heavy snow storm, with strong wind from the northeast, and drifts. This was followed by a few days of mild weather and a warm rain on the 26th. During late April and early May the weather was fine and cold, with light frosts at night. April 27th: Coltsfoot (tussilago farfara) in bloom at St. Stephen (J. V.); May 1st, in bloom at St. John; April 27th: Ribes fetidum in leaf under cliffs in Rockwood Park and alder catkins discharging pollen.

### Wild Garden, Ingleside.

*May* 4.—Plants in bloom: Hepatica, mayflower, red maple, and a few of the dog-tooth violet. Catkins of the trembling poplar, alder, and birches shedding pollen freely. Frost out of the ground in the clearings, but patches of ice and snow remain in the woods.

*May* 10.—White violets and strawberry plants beginning to bloom.

*May* 18.— Plants in bloom: Pappoose root (caulophyllum thalictroides), amelanchier, bluets, dandelion, marsh marigold, trillium grandiflorum (not native, but has bloomed regularly since it was transplanted from Ontario ten years since), trillium erythrocarpum, lonicera ciliata, alnus viridus, rhodora (a few), ribes fetidum, uvularia sessilifolia, anemone nemorosa, white and blue violets in great abundance, mayflowers in shaded places. Trees in leaf: Betula papyraceae, amelanchier canadensis, pyrus americana, acer spicatum. Coming into leaf: Elm, horse-chestnut, red maple, trembling poplar, red cherry, sugar maple, mountain maple.

Fine growing weather for the past week, with plenty of rain

and warm weather, hastening the vegetation, but the rain retarding farming operations.

*May* 25.— Weather cool at nights, with occasional light frosts, but the days warm, with showers alternating with sunshine. Purple trillium, red-berried elder, red-ozier dogwood, blueberry plants, trientalis americana, bog-bean and striped maple in blossom. Amelanchier everywhere in full bloom, its white blossoms in contrast with the vivid green of the new foliage. At no other season do our northern woodlands present a fairer picture than at this time. The deciduous trees are all in leaf, except the red oak, red ash, acacia and sumach. The white silky wool of the opening leaves of the large-toothed poplar give still another tint to the many tinted foliage of spring.

*May* 28.—The fallen petals of amelanchier begin to whiten the ground in the neighborhood of these trees. The white petals of the red cherry are fully expanded, keeping up the brightness of the woods for a week longer. The petals of the white trillium are beginning to fall. In bloom: The twisted-stalk (streptopus roseus), clintonia, crataegus, with the Siberian crab-apple and Persian pea of the gardens. Nearly all the ferns have unrolled their fronds.

*June* 10.—A few ripe strawberries found in sunny spots. In bloom: Iris versicolor, ledum latifolium, potentilla canadensis, cypripedium acaule.

*June* 12.—Weather cool. Light frosts on the night of 11th and 12th. Thermometer 40° F. at 6 a. m. on the morning of the 13th.

*August* 31.—Quite severe frosts in many places last night. The evenings have a decided chill. There are abundant rains at intervals. All through the summer there was very little continued hot weather.

*October* 13.—A cold wet autumn followed a cool summer, and the harvesters' work was greatly interfered with. On the night of October 7th the ice that had formed on a shaded wood road was visible at four o'clock in the afternoon of the following day.

November and early December had many warm days and clear crisp nights, reminding one of our usual October weather.

# APPENDIX.

## SUMMARY OF THE PRESIDENT'S ADDRESS.

On a previous occasion I made a reference to the great necessity which exists for the construction in St. John of some suitable building for the care and proper display of the various objects which are in the possession of this Society. We own a valuable museum, composed largely of specimens of the organic substances of our own Province; we have many articles of interest which have been gathered in foreign countries, gifts from thoughtful friends; we have an excellent library of useful books, chiefly of a scientific kind; and this library, while it is constantly growing in size, is scarcely available to the scientific student because of the small space into which it is crowded, and the consequent difficulty of classifying, or, rather, arranging it for the student's use. Although the ownership of all these is in the Natural History Society of New Brunswick, I may safely say that that Society has no narrow feeling of ownership. So far as it can, it opens its treasures to all who may desire to use them, in a truly scientific spirit, and it feels that it is merely a trustee for the public, managing property so that it may be conserved for the great purpose for which it was gathered, the diffusion of knowledge. We owe the city government acknowledgment of the fact that it gives us free of charge the premises which we occupy, but I am quite sure that it can be properly said we strive to make return by the use which is made of the property, by the broad spirit with which we open our doors to allow of the examination of the objects which are in our possession, by the efforts which we make to spread the bounds of knowledge by our lectures, and particularly by the special efforts which are made by some of our members to teach the young and to unroll before them the pages of knowledge upon which are written great truths concerning the life of the world. We have now in St.

John a public library building erected by the munificence of a philanthropic man who never saw our city, and who is animated solely by a desire to do good to the human race. The requirement which he makes of us, as citizens of this city, is that we shall year by year spend a specified sum in carrying out the purposes for which he provides the building. Into that contract we have entered cheerfully, and I have little doubt that its terms will be observed faithfully. But the public library building ought to be supplemented by such a building as I have suggested—as others have suggested before me—for the Natural History Society. A modest brickstructure, built upon a simple plan,sufficiently large to contain our museum and our library, and to allow something for their expansion, would not cost a great deal of money. There ought to be ten citizens of St. John willing, as there are surely many more than that number able, to give us a thousand dollars each with which to commence the work. With that sum in hand the road would be easy enough. I do not look with great favor upon the constant calls which are made upon the civic treasury to help this or that particular institution, but if we had a good sum in hand, if we showed willingness upon our own part to make a fair pecuniary effort for this undertaking, we may say to the city fathers, "We occupy by your grace premises which would bring you in an annual rental, if they were put upon the market, of so much money; in all human probability, and as long as we do fairly such work as we are doing now, you will continue us in the occupancy of these premises; but it might be quite as well for you, financially, to capitalize the value of the rental and give it to us. You will help a useful civic and public institution by doing so, and you will be recouped the outlay by the revenue which will accrue from the rooms which we now hold." But I feel that no such proposition can be made until at least we have in sight a good deal more money that we have now for the purpose. In some way we must make a commencement towards the accumulation of money for the purpose if we desire our work to continue successfully.

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Surely it is work that ought to continue. When I read in the papers or hear of discussions as to whether this particular subject

or the other should be taught in the public schools, or should form part of our college curriculum, I often feel, as no doubt you often feel, how much is not taught that ought to be taught. We cling to old systems of education with tenacity and sincerity. The youth of the country are compelled to go through courses of study from which they learn really little of the life that is about them, of the world in which they live, or, what is of more important still, of themselves. A man who became a great philosopher, and whose opinions and thoughts have had considerable influence upon the modern world, struggled from a Scottish village school to a famous university in his native country, but soon left it, as he discovered that it had little or nothing to teach him of the things which he wanted to know. In the past century, indeed in the past half century, real knowledge of the material world has accumulated so fast that it has gone far ahead of all our school books and of our school teaching, and we have scarcely noted the fact in our methods of education. The plants which grow around us, the trees which shelter us, or which adorn our parks, the insect world so full of strange life and often containing dangerous foes, the birds whose attractive forms are so agreeable to the eye and whose music is so grateful to the ear, the soil which produces for us articles of food, the stones from which we construct our houses are things of which we know too little, of which we teach the young scarcely anything, or of the mystery which lies in and beyond them, unless some enthusiastic student of any of these, who may be a school teacher, brings them within the reach of the pupil in a furtive and doubtful way. And so to most of us when our school days are over, as to Peter Bell in Wordsworth's poem, " the yellow primrose is but a yellow primrose, and nothing more." We are unconscious of the mystery of its life, of its far-off origin in the world of matter, of its relation to the law of substance, of the fact that it is constructed of the same material as that of which we are constructed, and that it lives not simply for us, but in obedience to universal law with a life such as it is that is all its own. I remember that when I was a boy at school, filled with a desire to know something about everything, I was told that everything which was on this earth was made for man's use, and that we should be very grate-

ful for the provision and the care which had thus stored up so much for us that was useful and good. This kind of instruction seemed to render unnecessary any detailed information as to the objects themselves, and therefore it was a duty to master all the more quickly the mystery of the multiplication table. The same kind of instruction is probably given yet to many young people. It is not very long since I heard a preacher of some eminence—in another city, of course—descant in his sermon upon the Divine wisdom which had stored up in the womb of earth the coal which is now the source of so much useful power that it might be ready for man when man was ready to use it. Perhaps the remark was not an unreasonable one from a theological point of view, and it sounded well. The scientific man, however, could probably maintain without much difficulty that the coal would be where it is if man had never come upon the earth to make use of it. The observation recalled to my mind the remark made by John Tyndall in one of his lectures thirty years ago. He was explaining to his audience the sources of motive power, and drawing comparisons between those substances whose atoms are still in action and those whose atoms have already closed in chemical union and are therefore dead. He named a number of these, and then said: "In this way we might go over nearly the whole of the material of the earth's crust, and satisfy ourselves that though they were sources of power in ages past, and long before any creature appeared on the earth capable of turning their power to account, they are sources of power no longer. And here," he said, "we might halt for a moment to remark on that tendency, so prevalent in the world, to regard everything as made for human use. Those who entertain this notion, hold, I think, an overweening opinion of their own importance in the system of nature. Flowers bloomed before men saw them, and the quantity of power wasted before man could utilize it is all but infinite compared with what now remains. We are truly heirs of all the ages; but as honest men, it behooves us to learn the extent of our inheritance, and as brave ones not to whimper if it should prove less than we had supposed."

The complaint—if you will call it a complaint—which I have made regarding what we teach the young in comparison with

what we should teach them is not a new one. It was again Tyndall, who, after pointing out that in our earliest youth almost all of our enjoyments are physical, and that the confectioner's shop occupies in our ideas the foreground of human happiness, remarks that there grows up in our minds, as thought ripens, the desire to penetrate into the character and causes of the phenomena presented to our observation, but we do not gratify this desire. An instance which he gives is typical: "A few days ago," he wrote, " a master of arts, who is still a young man, and, therefore, the recipient of a modern education, stated to me, that until he had reached the age of twenty years he had never been taught anything whatever regarding natural phenomena or natural law." Twelve years of his life previously had been spent exclusively among the ancients. Now valuable as the ancient learning may be, it is surely not wise "to sacrifice the hopes and aspirations of the Present out of deference to the Past." A man who has occupied a notable position in the affairs of our country once said within my hearing, a Canadian, be it remembered, that he was seven years old before he knew there was such a language as the English, and that he was twenty before he learned a word of it. I refer to this as showing limitations which may be placed consciously or unconsciously upon the instruction which is given the young, and upon the ease with which the avenues to real knowledge may be closed by custom, by prejudice, or perhaps by some paternal idea that we may know too much. Against such an idea as this the existence of our Natural History Society is a constant protest. Although it is thirty years since Tyndall uttered his complaint, the cause is not yet removed. In that notable work, written only four or five years ago, in which Hæckel endeavours to solve "The Riddle of the Universe," he complains that the knowledge of modern science is not applied in the great concerns of life, in the courts of justice, in the field of politics, in the work of government, and he justifies his complaint by the observation that we can only arrive at a correct knowledge of the structure of the social body, the state, through a scientific knowledge of the structure and life of the individuals who compose it, and the cells of which they are in turn composed. The first step in the direction which he would take is to reform the schools.

"Our education of the young," he declares, "is no more in harmony with modern scientific progress than our legal and political world." Physical science, which is so much more important than all other sciences, and which, properly understood, really embraces all the so-called moral sciences, is still regarded as a mere accessory in our schools, if not treated as the Cinderella of the curriculum. Most of our teachers still give the most prominent place to that dead learning which has come down from the cloistral schools of the middle ages. In the front rank we have grammatical gymnastics and an immense waste of time over a "thorough knowledge" of classics and of the history of foreign nations. Ethics, the most important object of practical philosophy, is entirely neglected. The valuable teaching of modern cosmology and anthropology, of biology and evolution, is most inadequately imparted, if not entirely unknown, in our higher schools, while the memory is burdened with a mass of philological and historical facts which are utterly useless, either from the point of view of theoretical education or for the practical purposes of life; and he adds that the antiquated arrangements of the universities are as little in harmony with our scientific knowledge as the curriculum of the primary and secondary schools. It can be said, at least for this distinguished professor of the University of Jena, that he does not fear to express his opinions.

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The President then proceeded to the consideration of the special theme which he discussed during the evening, viz., the relation of ordinary animal life, in its consciousness, to the life of man.

He inquired into the possibility of there being among insects and birds and animals a certain amount of race or family knowledge in addition to the mere experiences of indviduals. He expressed the belief that there was something more than mere instinct in the knowledge a butterfly—the ordinary cabbage butterfly—displayed in placing its eggs upon the cabbage plant. As a grub it had fed upon that plant; did it carry through its existence in the chrysalis form and into the prefect insect remembrance of its food when a mere grub? Was there a form of reasoning in its mind when, unable to find a cabbage, it sought some other

plant, rejecting many until it found one with food qualities resembling those of the cabbage? To seek to secure the propagation of its species might be properly attributed to what we called instinct, but the provision it made for the care of its children seemed to have in it something of reason. The mason wasp provided for its young by enclosing in the cell in which it laid its eggs, a spider or spiders which it paralyzed, so that when the egg hatched the young grub would have its food. The insect apparently had accurate knowledge how to paralyze the spider without killing it, and a fair knowledge of the quantity of food for each grub. It seemed to have race knowledge as well as individual knowledge and skill. The great philosopher, Descartes, taught that consciousness and thought are the prerogative of man alone, and there is a pretty general acceptance of his idea. He regarded the animal world — men excepted—as mere machines, whose acts were purely mechanical, and therefore uninfluenced in any way by thought. Yet bee-keepers will tell us that currents of information at times appear to run through a bee-hive, and the swarming of the bees seems to be a thoroughly planned scheme. Experiments made by Lubbock with ants showed that they possessed centres of intelligence in their congregations. These were low forms of creation, and they did not appear to apprehend man as a special factor in creation. But higher animals did. The swarming of birds was a kind of tribal movement, somewhat after the nature of the movements of the early Indians, who in the early days followed their food; but the bird took note of man, and its effort to deceive him as to the location of its nest or the hiding place of its young was a reasoned appeal to the consciousness of man, for the bird not only undertook to deceive him, but, evidently, assumed that it was possible to deceive him. Taking a still higher class of animals, the dog, for example, we could easily find in many of these, if we examined carefully, not only race feeling, but individuality in a marked degree. A good and seemingly honest dog living in the country will carefully guard his master's sheep, but at night will travel miles to a place where he knows of another flock, will murder a number of them and return to his home by early morning as meek-looking and as honest-appearing as though "'twere nothing he had done by

night." Of course it is easy to say that he has killed the sheep because of an instinct which has come to him through a remote ancestry. But think of what he has done. He has not only killed some sheep, but he has ingeniously planned to deceive his master and everybody else as to any connection of his with the crime, and he poses as an honest, well-behaved dog, deserving of confidence. His plans and his conduct show not only consciousness, but a sense of moral responsibility which he immorally violates. He reasons out the way of committing a crime, the possibility of detection, and the best plan of avoiding suspicion. In these and in other instances to which he referred, the President found evidence that reason existed in the animal world, and which justified the acceptance of the belief that the same principle of reason ran through all living things. He was inclined to this view. The difference was in degree. This led him to a statement of Hæckel's theory of the universe which he explained at some length, and with many illustrations and quotations from that writer's works, in support of his theory of the unity of nature and the law of substance. This theory eliminated entirely the idea of a Creator directing the affairs of the world, and referred all created things to a sensation, a force, a tendency, and out of this grew up not only all organisms, but also all the consciousness which existed in the animal world, a process of evolution producing the highest forms of intelligence, as well as the bodies through which this intelligence, consciousness and intellectual force was expressed. One of the quotations was as follows:

"The remarkable expansion of our knowledge of nature, and the discovery of countless beautiful forms of life, which it includes, have awakened quite a new æsthetic sense in our generation, and thus given a new tone to painting and sculpture. Numerous scientific voyages and expeditions for the exploration of unknown lands and seas, partly in earlier centuries, but more especially in the nineteenth, have brought to light an undreamed abundance of new organic forms. The number of new species of animals and plants soon became enormous, and among them (especially among the lower groups that had been neglected before) there were thousands of forms of great beauty and interest, affording an entirely new inspiration for painting, sculpture,

architecture, and technical art. In this respect a new world was revealed by the great advance of microscopic research in the second half of the century, and especially by the discovery of the marvellous inhabitants of the deep sea, which were first brought to light by the famous exploration of the Challenger (1872-1876). Thousands of graceful radiolaria and thalamophora, of pretty medusæ and corals, of extraordinary molluscs, and crabs, suddenly introduced us to a wealth of hidden organisms beyond all anticipation, the peculiar beauty and divinity of which far transcend all the creations of the human imagination. In the fifty large volumes of the account of the Challenger expedition, a vast number of these beautiful forms are delineated on three thousand plates; and there are millions of other lovely organisms described in other great works that are included in the fast-growing literature of zoology and botany of the last ten years. . . . . A man needs only to keep his eyes open and his mind disciplined. Surrounding nature offers us everywhere a marvellous wealth of lovely and interesting objects of all kinds. In every bit of moss and blade of grass, in every beetle and butterfly we find, when we examine it carefully, beauties which are usually overlooked. Above all, when we examine it carefully with a powerful glass, or, better still, with a good microscope, we find everywhere in nature a new world of inexhaustible charms.

"But the nineteenth century has not only opened our eyes to the æsthetic enjoyment of the microscopic world; it has shown us the beauty of the greatest objects in nature. Even at its commencement it was the fashion to regard the mountains as magnificent, but forbidding, and the sea as sublime, but dreaded. At its close the majority of educated people—especially they who dwell in the great cities—are delighted to enjoy the glories of the Alps and the crystal splendor of the glacier world for a fortnight every year, or to drink in the majesty of the ocean and the lovely scenery of its coasts. All these sources of the keenest enjoyment of nature have only recently been revealed to us in all their splendor, and the remarkable progress we have made in facility and rapidity of conveyance have given even the less wealthy an opportunity of approaching them. All this progress in the esthetic enjoyment of nature—and proportionately, in the

scientific understanding of nature—implies an equal advance in higher mental development, and consequently in the direction of our monistic religion."

The President remarked that while it was not impossible to conceive matter progressing from one stage to another until it is arranged in subtle and highly nervous form, it seems to be almost impossible to conceive of its inert masses becoming endowed with the capacity, through an evolving process, to think, to hope, to aspire, to imagine itself in fellowship with the Almighty and to plan for its continuance in some form for an immortal, a never-ending existence.

In fact while we might argue that there is practically no difference, except in degree, between the consciousness of the animal creation and the consciousness of man in all matters where experience exists; while it might be mentioned that at some time in the evolutionary process consciousness emerged—even though we are unable to say from what or whence it emerged—we are bound to take note of the imaginative capacity, which is not in any way based upon our human experiences, of those prodigous projections of the intellect into conceptions of a future of which we have no experiences or sensations, of those marvellous flights of fancy in which man displays his own creative faculty independent entirely of and beyond the ordinary concerns of the life in which he exists. The scientific man, by close observation, by patient investigation, is able to unravel some of the secrets of nature, to grasp the physical facts connected with the life of our world and applying his generalization of the past to his observation of the present create anew the earth. In this he is only —effective as is the work, and correctly as it may be done—giving the results of recorded observations and determined facts, but when the human intellect, invading the realms of fancy, creates new worlds, conceives new conditions of life which are outside and beyond all human experience, and independent of any actual knowledge, it passes beyond the limitations of matter in any of its forms, and, it seemed to him, "threw doubt, very great doubt, upon the theory that all consciousness is but a quality of highly organized matter. Perhaps, too, it would not be improper here to say that it is no easy task which the extreme evolutionist has

undertaken when he attempts to explain the moral sense by the operation of an evolutionary law. * * * * At this point I leave my subject, for I have no desire whatever to enter the metaphysical labyrinth which opens before me. I can only say that as investigators of natural history, our plain duty is to endeavor to ascertain, as far as possible, the exact truth as regards every known thing, to examine, to investigate, to compare; and yet to formulate no theories which we cannot establish by facts which are within our reach; to shrink from no examination which we may fairly make, to shirk no investigation of matter in whatever form it may present itself for fear of some result which will destroy a cherished theory, ever remembering that we are seeking not merely to wrest some secret from nature's well guarded store, but that we are seeking after truth; not alone for the satisfaction which we will undoubtedly derive from the attainment of knowledge, but for the good which must accrue to mankind as a knowledge of the universe is diffused; and as we master the fact that the sum of human happiness will be enlarged if we apply that knowledge honestly, justly and fairly to all the concerns of life. This, at least, is a work which we ought to be able to perform, and yet it may demand of us the most difficult of human sacrifices, the sacrifice of self!"

# FORTY-THIRD ANNUAL REPORT

OF THE

# COUNCIL OF THE NATURAL HISTORY SOCIETY

OF

# NEW BRUNSWICK.

The Council of the Natural History Society of New Brunswick submits the following report for the year ending December 31st, 1904:

### MEMBERSHIP.

During the year the membership has been increased by the admission of ten ordinary, twenty-one associate and two junior members, making a total of 195.

The following shows the numbers, classes and total enrolled membership:

| | |
|---|---|
| Honorary, | 4 |
| Life, | 6 |
| Corresponding, | 24 |
| Ordinary, | 59 |
| Associate, | 98 |
| Junior, | 4 |
| Total, | 195 |

### TREASURER'S REPORT.

*Income—*

| | | |
|---|---|---|
| Balance from 1902-3, | $577 64 | |
| Interest on investments, | 135 16 | |
| Bulletins sold, | 2 45 | |
| Government grant, | 200 00 | |
| Membership fees, | 145 00 | |
| Dividend Botsford estate, | 10 00 | |
| Donations, | 1 50 | |
| | | $1,071 75 |

*Expenditures—*

| | | |
|---|---|---|
| Maintenance of Museum,.. | $286 50 | |
| Library books and binding, | 8 75 | |
| Printing and distributing Bulletin XXII, | 267 31 | |
| Sundries,.. | 267 26 | |
| Balance, | 241 93 | |
| | | $1,071 75 |

Of the above balance, $33.00 is held in trust for the Ladies' Association, and $40.00 for botanical work, as set forth in last year's report.

The Society owns, besides a $1,500.00 mortgage (protected by insurance), $1,000,00 special deposit in the Bank of Nova Scotia.

It seems in order to again call attention to the Building Fund, which consists only of the donation of $10.00 in 1897, and the interest that amount has earned. The collections are insured for $2,500.00.

A. Gordon Leavitt,
*Treasurer.*

LIBRARY.

The books in the library have been re-arranged. A catalogue in manuscript has been prepared, a number of pamphlets bound, and others are ready to be sent to the binder. The assistant curator has taken charge of the work this year. There is urgent need of an active library committee to complete the work of cataloguing the books.

PUBLICATIONS.

Bulletin XXII has been published during the year, containing articles on natural science by various members of the Society, and fully as large and as well illustrated as any previous Bulletin. Several of the papers of more general interest read before the Society were published in the daily press.

LECTURES.

Eleven regular meetings, including the annual meeting, and one special meeting, were held during the year.

The following are the dates of the meetings and the titles of papers read:

1904.

January 5.—(*a*) Describing Indian remains found on opening Indian graves in the vicinity of Tracadie, by Dr. A. C. Smith.

(*b*) Describing the location of certain beds of fossil mussel shells, by Mr. J. P. Clayton.

(*c*) The Physiography of the Northwest Miramichi, by Professor W. F. Ganong.

(*d*) Ornithology—Past and Present, by A. Gordon Leavitt.

January 19.—Annual Meeting. Reports received. President's address. Election of Officers.

February 2.—(*a*) Weeds and their Persistence, by Mr. J. Vroom.

(*b*) Certain Natural History Curiosities said to occur in New Brunswick, by Professor W. F. Ganong.

March 1.—(*a*) House Flies and their Relations, by Mr. Wm. McIntosh.

(*b*) New Brunswick Animals and Animal Romancers, by Professor W. F. Ganong.

April 5.—(*a*) On the Physical Aspect of the Cambrian System in Eastern Canada, by Dr. G. F. Matthew.

(*b*) The Earthquake of March 21st, 1904, by Mr. S. W. Kain. Also a communication on the same subject from Mr. W. B. Hoyt.

(*c*) A canoe trip on the Northwest Oromocto Lakes, and down the Northwest Branch in company with Professor W. F. Ganong during the summer of 1903, by Dr. G. U. Hay.

May 3.—(*a*) The Commercial Value of Birds, by Mr. J. W. Banks.

(*b*) Notes on New Brunswick Birds, by Mr. W. H. Moore.

May 12.—A special meeting for the purpose of taking into account the providing of hospitality for the delegates of the Royal Society of Canada.

June 7.—Burr-Balls of Little Kedron Lake, by Professor W. F. Ganong.

October 4.—Mushrooms and Toad-stools — How to know them, by Dr. G. U. Hay.

November 1.—(*a*) The Human Telephone, by Professor L. W. Bailey.

(*b*) A Measure of the Rate of Recession of the Coastline of New Brunswick. New Aneroid Measurements in New Brunswick. The Physiographic Characteristics of the Renous River, by Professor W. F. Ganong.

December 6.—(*a*) An Earthenware Pot of the Stone Age, by Dr. G. F. Matthew and Mr. S. W. Kain.

(*b*) Synopses read, of papers prepared by Professor W. F. Ganong.

An elementary course of lectures was given during January, February and March in the Society's rooms at 8 o'clock on the Tuesday evenings not occupied by the regular meetings. These lectures were for members, for children in the schools, and others interested in the natural sciences.

The following were the dates and the titles of papers read:

Dr. G. F. Matthew gave two lectures: January 12—How hills and valleys are made (with special reference to those in our own vicinity). January 26—Why sea shells are found on the mountains.

Mr. Wm. McIntosh gave four lectures: February 7—Things seen on a day's ramble. February 16—A general view of insects. February 23—Butterflies and moths. A view of Mr. McIntosh's fine collection. March 8—Things seen on the seashore.

Mr. A. Gordon Leavitt gave one lecture, March 15, on Bees, Wasps and their allies.

March 22.—An evening with the microscope, by members of the Microscopical Section.

March 29.—View of collections in the Museum under the direction of Dr. G. U. Hay and Mr. A. G. Leavitt.

To pupils of Grades VII and VIII of the public schools prizes were offered for the best written series of notes on the lectures. The children showed great interest in the lectures, and several essays were submitted. The first prize was awarded to D. W. Hodsdon, and the second to Colin G. Leavitt.

### Library and Museum.

The library and museum have been opened to visitors three afternoons of each week — Tuesday, Thursday and Saturday. The assistant curator, Miss Florence A. Hoyt, has been in charge.

The number of visitors during the year has been 105 adults and 402 children.

Changes have been made in two rooms of the museum—adding to the cases, renovating the specimens, and displaying them to greater advantage.

The new show case in the reptiles and fish room adds much to the appearance of this part of the museum.

### Archaeology.

During the past year Mr. Duncan London, of Lakeville Corner, Queens County, one of our corresponding members, has found a number of interesting relics of the Stone Age. In August, 1904, he was fortunate enough to discover a large number of pottery fragments, representing one earthen vessel. This find has proved of very great interest, and Dr. G. F. Matthew

and Mr. S. W. Kain prepared and presented an interesting paper, published in this Bulletin, describing the piece of pottery. From this specimen we are able to form an excellent idea of the size of earthen vessels used by the men of the Stone Age, and the method of the decoration practised.

### GEOLOGY.

There is not much to record of geological discovery in New Brunswick. Members of the Society have been at work in the northern part of the province. Professor Bailey has discovered confirmation of the reference of the slates of the Teteagouche river to the Ordovician system, in the presence of certain graphtolites. He also reports the presence of valuable iron deposits there. By means of a magnetic instrument, a valuable iron ore ode has been located at New River, in Charlotte County. Small veins only had been known in this district before.

Professor Ganong has been pursuing his explorations in the north of the province, and is giving the result in the series of articles he is publishing in this Bulletin.

### BOTANY.

(See special articles, pp. 358–365.)

### GENERAL.

The Royal Society of Canada met in St. John during the week beginning June 20th, on the occasion of the Tercentenary of Champlain's discovery of the St. John harbor. Our Society undertook, with the Historical and Loyalist Societies, the duty of entertaining the members, which was done, it is believed, to the satisfaction of the members of that society and to the credit of the city. The President of this Society and the Council took a prominent part in the entertainment of the guests, and the ladies of the Ladies' Association, in conjunction with lady representatives of the Historical and Loyalists' Societies, gave a drive through Rockwood Park and a picnic at Duck Cove, which were greatly enjoyed by the visitors.

The reception given by Senator and Mrs. J. V. Ellis was a very pleasant function, affording many citizens an opportunity

to meet the members of the Royal Society. A morning outing on the harbor, arranged by Senator Ellis, and a luncheon by His Worship Mayor White, were other social events greatly enjoyed by citizens and their guests.

The Ladies' Association has co-operated in the work of the Society. The Council especially expresses its appreciation of the work done for the entertainment of the Royal Society. The report of the Ladies' Association is appended hereto.

The curator, Miss Hoyt, has attended to her duties during the year to the satisfaction of the Council. Our grateful acknowledgments are due to the press of the city for free publication of notices and reports of meeting, and to those who have read papers before the Society.

# REPORT OF THE LADIES' ASSOCIATION OF THE NATURAL HISTORY SOCIETY.

The work of the associate members has gone on as usual during the past year. The number of members has increased largely, being now nearly one hundred, and the interest in the work of the Society has grown in even greater measure.

The Thursday afternoon lecture course for 1903-4 was exceptionally good, and very well attended. Of special value and interest were the lectures to the children. The school children attended in large numbers. Invitations were sent to the teachers of certain schools to select a number from their classes who would be interested in the subject for each date respectively, and invite them to the lecture. So many came that the rooms were overcrowded, and the regular members of the Society could not even find standing room. We felt the need of more commodious rooms.

We were delighted to welcome to our course of lectures Miss Ganong, of Rothesay, who gave two lectures, one on the Mollusca and one on the Singing Birds. After the second lecture Miss Ganong made an appointment to meet the young pupils in Rockwood Park at seven o'clock of a Saturday morning to give them a practical lesson in distinguishing birds by their song. To her surprise no less than fifty came out to the Park to make acquaintance with the birds in their native haunts.

In the beginning of the summer the Ladies' Association united with the ladies of the Historical and Loyalist Societies in arranging for a picnic and drive to Duck Cove in given honor of the Royal Society of Canada, which was holding its annual meeting at St. John on the occasion of the Tercentenary of Champlain's discovery of the river St. John. The weather proved disagreeable, but apart from this the entertainment was a success in every way.

A programme of lectures for this winter has been arranged, and is being carried out. It began with a conversazione, which

was successfully conducted by the Associate members. Two lectures of the course have already been given. They were well attended, notwithstanding the stormy weather.

The Association has buisied itself in procuring donations to the library and museum, and is pleased to report continued interest in the latter. The museum is open to the public on three afternoons in the week—Tuesday, Thursday and Saturday. Many school children come, and some teachers regularly bring classes and give them object lessons in Natural History.

There is every prospect that the current season will prove not less useful and interesting to the members than former ones, and I would express the hope that the year will not pass without some steps being taken toward the better housing of the museum and library, which should be a source of pride and a centre of interest to the citizens of St. John.

K. M. MATTHEW,
*President of the Ladies' Association of the N. H. S. of New Brunswick.*

St. John, N. B., January 19, 1905.

## DONATIONS TO THE MUSEUM, 1904.

| DATE. | DONOR'S NAME AND DESCRIPTION OF GIFTS. |
|---|---|
| January... | A. C. Smith. Steel axe, cod hook, fish harpoon, iron scrapers.<br>Mr. Clayton. Specimen of mussel shells.<br>Geoffrey Stead. Crude petroleum. |
| February.. | J. London. Specimens stone net sinkers of the Indian period. |
| March..... | Miss Emma Disbrow. Snake skin, found on Judge Cushing's grave at Greenbush, U. S. A. |
| June....... | Col. A. Markham. A matrix, in which opals are found. |
| October ... | Mr. Geo. Batson. Model of a Viking ship.<br>A. C. Smith. An Indian relic.<br>Miss Hunt. Arrow heads.<br>Rev. W. C. Gaynor and Dr. G. U. Hay, Specimens of fungi. |
| November | G. M. Duncan, M. D. Specimens of couch-grass.<br>Master W. Jones. The dry part of tamarind, nut galls, and portion petrified stump of red wood tree.<br>Duncan London. Earthen pot of the stone age. |
| December. | Mrs. C. E. Huestis. Specimen of fossil oyster. |

# DONATIONS TO THE LIBRARY, 1904.

| DONOR'S NAME. | RESIDENCE | WORKS. |
|---|---|---|
| Academy of Natural Science | Philadelphia | Proceedings |
| Academie Imperiale des Sciences | St. Petersburg. | Bulletins |
| American Entomological Society | Philadelphia | Circulars |
| American Museum of Natural History | New York | Bulletins |
| Australian Museum | Sydney, N. S. W | Reports |
| Amherst College | Amherst, Mass | Reports |
| Archaeological Society | Ontario | Reports |
| Boston Society of Natural History | Boston | Bulletins |
| Boston Free Public Library | Boston | Reports |
| Buffalo Society of Natural Science | Buffalo | Bulletins |
| Bureau of Ethnology | Washington | Transactions |
| California Academy of Science | San Francisco | Proceedings |
| Cincinnati Society of Natural History | Cincinnati | Bulletins |
| Colorado Scientific Society | Denver | Transactions |
| Connecticut Academy of Science and Art | New Haven | Bulletins |
| Cornell University Library | Ithaca, N. Y. | Report |
| Comite Geologique | St Petersburg | Report |
| Canadian Institute | Toronto | Transactions |
| Davenport Academy of Natural Science | Davenport | Proceedings |
| Director Royal Gardens | Kew, G. B | Bulletins |
| Department of Inland Revenue | Ottawa | Report |
| Entomological Society | London, Ont | Journal |
| Feuille des Jeunes Naturalistes | Paris | Journal |
| Field Naturalist Club | Ottawa | Transactions |
| Gray Herbarium | Cambridge, Mass | Bulletin |
| Geological Survey | Perth, W. A | Report |
| Geological Society | London | Report |
| Geological Survey | Ottawa | Report |
| Historical and Scientific Society of Manitoba | Winnipeg | Bulletin |
| Indiana Geological Survey | Indianapolis | Report |
| Iowa Geological Survey | DesMoines | Report |
| John Hopkins University | Baltimore | Circular |
| Linnæan Society | New South Wales | Report |
| Liverpool Biological Society | Liverpool | Proceedings |
| Lloyd's Museum | Cincinnati | Report |
| Manchester Geological Society | Manchester | Proceedings |
| Minnesota Academy of Natural Science | Minneapolis | Bulletin |
| Minister of Mines | Sydney, N. S. W | Report |
| Missouri Botanical Gardens | St. Louis | Proceedings |
| Maryland Geological Survey | Baltimore | Report |
| National Museum Library | Washington | Proceedings |
| Natural Science Association | New Brighton | Bulletin |
| New York Academy of Science | New York | Journal |
| New York Public Library | New York | Bulletin |
| Ottawa Literary and Scientific Society | Ottawa | Bulletin |
| Philadelphia Museum | Philadelphia | Report |
| Public Museum | Milwaukee | Report |
| Queens Quarterly | Kingston | Report |
| Rochester Academy of Science | Rochester | Proceedings |
| Royal Academy of Science | Stockholm | Proceedings |
| Royal Colonial Institute | London | Journal |
| Royal Geographical Society | London | Proceedings |
| Royal Society of Canada | Ottawa. | Proceedings |
| Smithsonian Institution | Washington | Proceedings |
| South Dakota School of Mines | Rapid City | Report |
| Texas Academy of Science | Austin | Report |
| University of Toronto | Toronto | Proceedings |
| University of California | California | Report |
| U. S. Coast and Geodetic Survey | Washington | Bulletin |
| U. S. Fish Commission | Washington | Report |
| U. S. Commission of Agriculture | Washington | Circular |
| U. S. Geological Survey | Washington | Report |
| Wilson Bulletin | Oberlin, Ohio | Bulletin |
| Wisconsin Natural History Society | Milwaukee | Proceedings |

# OFFICERS AND COMMITTEES OF THE NATURAL HISTORY SOCIETY FOR 1905.

## PATRON.

His Honour the Lieutenant Governor, Hon. J. B. Snowball, LL. D.

## COUNCIL.

*President*—Hon. J. V. Ellis.
*Vice-Presidents*—G. F. Matthew, G. U. Hay.
*Treasurer*—A. Gordon Leavitt.
*Secretary*—W. L. McDiarmid.
*Librarian*—W. L. Ellis.
*Curators*—S. W. Kain, Wm. McIntosh, J. W. Banks.
*Additional Members of Council*—H. G. Addy, J. Roy Campbell, James A. Estey.

## LADIES' ASSOCIATION BRANCH.

*President*—Mrs. G. F. Matthew.
*Vice-Presidents*—Mrs. G. U. Hay, Mrs. H. G. Addy.
*Secretary-Treasurer*—Miss Edith McBeath.

## STANDING COMMITTEES.

*Archaeology*—S. W. Kain, A. C. Smith, M. D., Miss A. D. Jack.
*Botany*—G. U. Hay, W. F. Ganong, John Brittain, James Vroom.
*Entomology*—William McIntosh, A. G. Leavitt.
*Finance*—A. G. Leavitt, J. Roy Campbell, W. F. Hatheway.
*Geology*—G. F. Matthew, L. W. Bailey, Geoffrey Stead.
*Lectures*—G. U. Hay, H. G. Addy, G. F. Matthew, J. A. Estey.
*Library*—W. L. Ellis, Wm. McIntosh, Mrs. G. U. Hay, Mrs. W. F. Hatheway, Miss McBeath.
*Microscopes*—W. L. Ellis, G. G. Melvin, W. H. Mowatt.
*Ornithology*—A. G. Leavitt, Wm. White, J. W. Banks, Mrs. G. U. Hay.
*Press*—G. U. Hay, A. G. Leavitt, Wm. McIntosh, W. L. McDiarmid.
*Publications*—G. F. Matthew, S. W. Kain, G. U. Hay, A. G. Leavitt, W. L. McDiarmid.
*Rooms*—H. G. Addy, Mrs. G. F. Matthew, Mrs. G. U. Hay.

## LIST OF MEMBERS.

### Patron.

The Lieutenant Governor, Hon. Jabez Bunting Snowball, LL. D.

### Honorary Members.

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Ganong, Professor W. F., Ph. D......Smith College, Northampton, Mass.
Laflamme, Mgr. J. C. K......................Laval University, Quebec.
Marr, Professor John E............St. John's College, Cambridge, G. B.

### Life Members.

Chamberlain, M. ........................................Boston, Mass.
Hay, G. U., D. Sc....................................St. John, N. B.
Hegan, Jas. B................................Charlottetown, P. E. I.
Matthew, Geo. F., D. Sc.............................St. John, N. B.
Matthew, Robt...................................Cienfuegos, Cuba.
Kain, S. W..........................................St. John, N. B.

### Corresponding Members.

Baxter, Dr. John....................................Chatham, N. B.
Brittain, John ................................Fredericton, N. B.
Butler, W. S.............................Butler's, Queens Co., N. S.
Chalmers, Robert .......................................Ottawa, Ont.
Cox, Philip, Ph. D..................................Chatham, N. B.
Duncan, G. M., M. D................................Bathurst, N. B.
Duff, Professor A. W., Ph. D......................Worcester, Mass.
Forer, Henry....................................... Liege, Belgium.
Fowler, Rev. Professor James, A. M...................Kingston, Ont.
Gilmour, Dr.............................................Quaco, N. B.
Gesner, G. W...............................................New York.
Kirkland, R. J., LL. D..........................Grand Rapids, Mich.
London, Duncan..............................Lakeville Corner, N. B.
MacKay, Dr. A. H., LL. D............................Halifax, N. B.
McLaughlin, D. J. W...........................Grand Manan, N. B.
Matthew, Rev. C. R.................................Kingsville, Ont.
Moser, John..................................Butternut Ridge, N. B.
Perkins, Henry F., Ph. D...........................Hartland, N. B.
Smith, A. C., M. D.................................Tracadie, N. B.
Stead, Geoffrey.....................................Chatham, N. B.
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Vroom, James...........................................St. Stephen.
Walker, Byron E.....................................Toronto, Ont.
Wilson, W. J.........................................Ottawa, Ont.

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Barnhill, Geo. E.
Burditt, W. F.
Banks, J. W.
Belyea, J. Fred.
Beveridge, James
Campbell, J. Roy
Clarke, C. P.
Caritte, Ray
Ellis, Hon. J. V., LL. D.
Ellis, W. L., M. D.
Estey, James A.
Fairweather, G. Ernest
Fisher, W. S.
Fotheringham, Rev. T. F.
Frink, J. H., V. S.
Gilmour, A. B.
Hubbard, W. W.
Hall, Percy G.
Hall, Gilbert M.
Hatheway, W. F.
Howe, John D.
Hannington, T. B.
Inches, R. P., M. D.
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Melvin, Geo. G., M. D.
Mowatt, W. H.
Mowatt, James
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Morrison, W. S., M. D.
Murray, Geo.
McIntosh, W.
McDiarmid, W. L.
Phillips, Wm.
Reynolds, James
Rowe, Chas. F. B.
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Scammel, J. R., C. E.
Seeley, Alfred
Shewan, E. T. P., C. E.
Skinner, Hon. C. N.
Starr, F. P.
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Scott, Walter
Thompson, Enoch
Vroom, Wm. E.
Walker, James, M. D.
Wetmore, H. C., D. D. S.
Wilson, J. E.
White, W. W., M. D.
White, Wm.

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Adam, Miss Helen
Alward, Mrs. Silas
Anderson, Miss Mary
Abbot, Mrs. E. N.
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Bullock, Mrs. T. H.
Bustin, Miss Anna
Barker, Miss Helen
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McBeath, Miss Edith
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Murphy, Miss Grace
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Nixon, Mrs. G. H.
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Fiske, Mrs. Emma
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Gerow, Mrs. G. W.
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Gorham, Mrs. F. C.
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Thompson, Mrs. Mary
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Titus, Mrs. F. R.
Taylor, Mrs. E. R.
Wade, Mrs. John
Wardroper, Mrs. H. E.
Warner, Mrs. James
Whitney, Mrs. Jas.
Wright, Miss
Wetmore, Mrs. H. C.

## ST. JOHN OBSERVATORY.

### METEOROLOGICAL SERVICE OF CANADA.

Latitude 45.17 N. Longitude 66.4 W.

| Months | Barometer | | | Thermometer | | | *Cloudiness:* 9 = Clear 10 = Wholly Clouded | *Precipitation:* Rain & Melted Snow | Thunder Storms | Fogs |
|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | Highest | Lowest | Mean | Max. | Min. | | | | |
| January ... | 30.04 | 30.75 | 29.22 | 14.8 | 42.2 | —14.7 | 5 | 4.36 | 0 | 3 |
| February .. | 29.99 | 30.62 | 28.97 | 14.9 | 44.2 | —14. | 5 | 3.07 | 0 | 0 |
| March. .... | 30.03 | 30.99 | 29.35 | 28.7 | 46.3 | —1.3 | 5 | 5.27 | 1 | 2 |
| April. ..... | 29.97 | 30.57 | 29.45 | 38.4 | 63.2 | 17 | 6 | 4.47 | 0 | 6 |
| May... ... | 30.00 | 30.32 | 29.58 | 51.9 | 72.5 | 33 | 6 | 2.81 | 1 | 4 |
| June ...... | 30.03 | 30.47 | 29.52 | 56.2 | 79.2 | 41 | 6 | 1.75 | 0 | 7 |
| July. .... | 29.98 | 30.23 | 29.53 | 61.6 | 81. | 50.3 | 7 | 3.47 | 1 | 18 |
| August .... | 30.03 | 30.40 | 29.70 | 60.6 | 76.4 | 46.4 | 6 | 6.50 | 1 | 8 |
| September. | 30.07 | 30.56 | 29.14 | 54.2 | 68.5 | 34.5 | 5 | 4.44 | 0 | 6 |
| October.... | 30.02 | 30.52 | 29.01 | 46.7 | 65. | 27 | 6 | 4.08 | 1 | 3 |
| November . | 29.83 | 30.41 | 28.64 | 34. | 49.9 | 12.5 | 7 | 2.40 | 0 | 1 |
| December.. | 29.93 | 30.52 | 29.18 | 16.5 | 46.2 | — 6.8 | 5 | 1.60 | 0 | 1 |

The mean height of barometer for year was 29.993. The highest reading was 30.990, on 5th March, and the lowest 28.637, on 14th November. The mean temperature for year was 39.9, being 2 degrees colder than average. Maximum temperature 81, on 9th July; minimum, —14.7, 2nd of January. The total precipitation, 44.22 inches, was 1.86 inches less than average. First frost occurred on 9th September; last frost 2nd of May.

D. LEAVITT HUTCHINSON,
Director St. John Observatory.

## WIND DIRECTION AND VELOCITY.

| | N. | | N. E. | | E. | | S. E. | | S. | | S. W. | | W. | | N. W. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MONTHS | Hours | Miles | Hours | Miles | Hours | Miles | Hours | Miles | Hours | Miles | Hours | Miles | Hours | Miles | Hours | Miles | Hours Calm | Total Miles |
| January... | 148 | 1272 | 120 | 1213 | 28 | 395 | 19 | 378 | 4 | 89 | 16 | 302 | 93 | 1282 | 214 | 3059 | 102 | 7,990 |
| February.. | 215 | 2465 | 108 | 1190 | 9 | 71 | 8 | 173 | 16 | 386 | 37 | 704 | 79 | 1497 | 214 | 3338 | 10 | 10,324 |
| March.... | 96 | 1194 | 48 | 247 | 69 | 660 | 48 | 721 | 61 | 625 | 102 | 1605 | 38 | 369 | 227 | 4216 | 55 | 9,637 |
| April...... | 120 | 329 | 38 | 871 | 82 | 1473 | 41 | 566 | 100 | 527 | 112 | 881 | 68 | 381 | 25 | 1410 | 134 | 6,438 |
| May ..... | 83 | 1078 | 46 | 508 | 140 | 1697 | 57 | 714 | 185 | 1736 | 140 | 1910 | 38 | 339 | 26 | 362 | 29 | 8,344 |
| June...... | 87 | 1035 | 56 | 709 | 46 | 336 | 68 | 531 | 228 | 1821 | 134 | 1484 | 4 | 7 | 48 | 590 | 49 | 6,513 |
| July .. ... | 40 | 580 | 17 | 107 | 26 | 216 | 30 | 256 | 373 | 2634 | 132 | 1803 | 16 | 86 | 56 | 622 | 54 | 6,304 |
| August.... | 120 | 1529 | 11 | 81 | 24 | 135 | 17 | 201 | 283 | 2060 | 150 | 2012 | 24 | 266 | 14 | 232 | 101 | 6,516 |
| September. | 67 | 559 | 16 | 90 | 32 | 352 | 30 | 473 | 140 | 1508 | 214 | 3183 | 126 | 1592 | 39 | 457 | 56 | 8,214 |
| October.... | 81 | 1166 | 74 | 761 | 34 | 189 | 28 | 558 | 42 | 449 | 210 | 3745 | 96 | 994 | 138 | 2013 | 41 | 9,875 |
| November.. | 114 | 966 | 145 | 2262 | 7 | 76 | 4 | 37 | 13 | 116 | 84 | 1402 | 31 | 203 | 244 | 3433 | 78 | 8,495 |
| December.. | 133 | 986 | 107 | 1131 | 10 | 141 | 10 | 225 | 17 | 382 | 28 | 596 | 25 | 275 | 342 | 4545 | 72 | 8,281 |

# TICE.

The Bulletins of the Society contain the following articles, among others:

| | PRICE |
|---|---|
| Bulletin VI.—Relics of the Stone Age in New Brunswick, by Loring W. Bailey; Native Mollusca of New Brunswick, by W. F. Ganong. | $0 50 |
| Bulletin VII.—Historical Sketch of the Natural History Society, by LeB. Botsford; Echinoderms of New Brunswick, by W. F. Ganong. | 50 |
| Bulletin VIII.—Economic Mollusca of New Brunswick, by W. F. Ganong. | 50 |
| Bulletin IX.—Sketch of Prof. C. F. Hartt; Archæozoon Acadiense—Laurentian Sponges, by Geo. F. Matthew. | 50 |
| Bulletin X.—Discoveries at a Village of the Stone Age at Bocabec, N. B.; Fossiliferous Horizons of the Cambrian Rocks at St. John, N. B., by Geo. F. Matthew. | 50 |
| Bulletin XI.—The Climate of Acadia in the Earliest times, by Geo. F. Matthew; Observations on some New Brunswick Fishes, by Philip Cox. | 50 |
| Bulletin XII.—An Outline of Phytobiology, by W. F. Ganong; Crystalline Rocks near St. John, by W. D. Matthew; Outlets of the St. John River, by G. F. Matthew. | 50 |
| Bulletin XIII.—An Outline of Phytobiology, by W. F. Ganong; Ichthyology of New Brunswick, by Dr. Cox; Volcanic Rocks of Maritime Provinces, by W. D. Matthew. | 50 |
| Bulletin XIV.—Sketch of Dr. Gesner; Flora of the Restigouche, by G. U. Hay; Remarkable Sounds in the Bay of Fundy, by W. F. Ganong; Two Shrews new to New Brunswick, by Dr. P. Cox. | 50 |
| Bulletin XV.—Abraham Gesner, a review of his scientific work; An extinct Palæozoic Insect, G. F. Matthew; Intrusive Rocks near St. John, W. D. Matthew; Tidal Phenomena at St. John, A. W. Duff. | 50 |
| Bulletin XVI.—Life of Dr. James Robb, L. W. Bailey; Earthquakes in New Brunswick, S. W. Kain; List of Mosses, J. Moser; Recent Discoveries in the St. John Group, G. F. Matthew; Natural History and Physiography of New Brunswick, W. F. Ganong. (This is continued in the four next Bulletins). | 50 |
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# BULLETIN

OF THE

# NATURAL HISTORY SOCIETY

OF

# NEW BRUNSWICK.

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No. XXIV.

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VOLUME V. PART IV.

PUBLISHED BY THE SOCIETY.

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SAINT JOHN, N. B.:
BARNES & CO., PRINTERS, PRINCE WILLIAM STREET.
1906.

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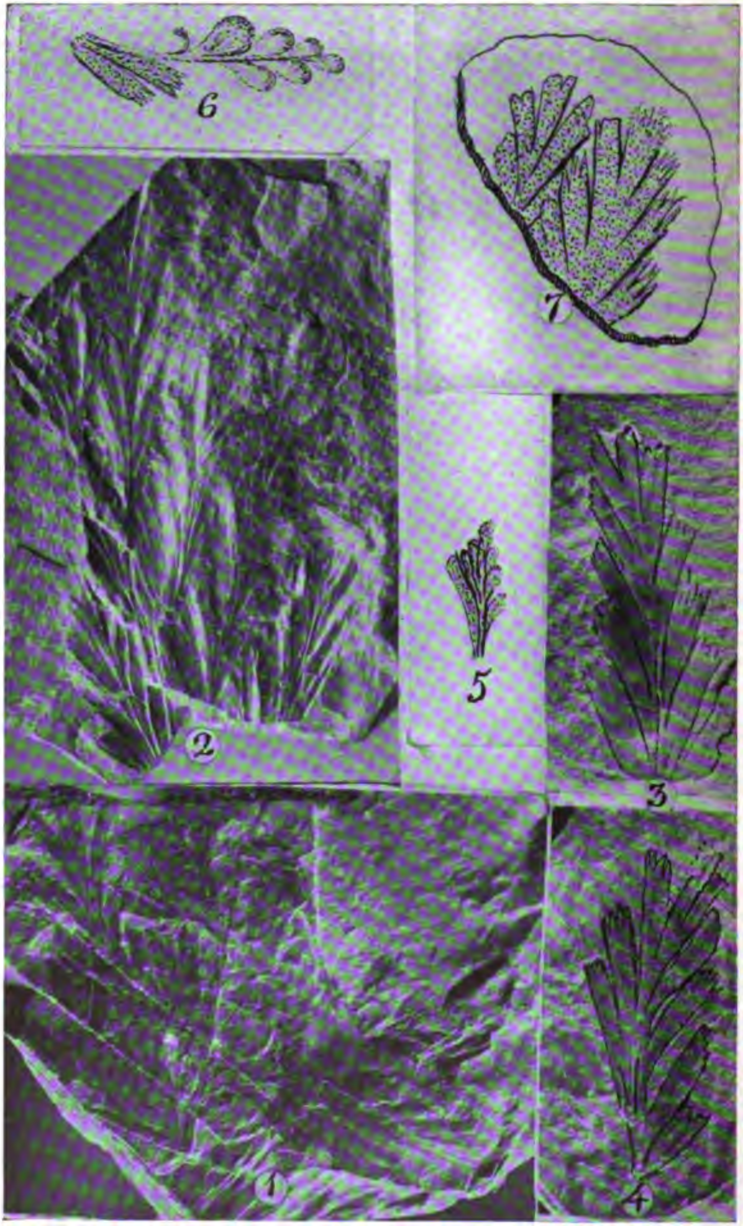



PSEUDOBAIERA MCINTOSHI, n. sp. and mut, FLABELLA.

## ARTICLE I.

# NEW SPECIES AND A NEW GENUS OF DEVONIAN PLANTS.

By G. F. Matthew, LL.D., D.Sc., F.R.S.C.

Read February 4, 1906.

Some members of our Society have, during the past summer, given a good deal of attention to the collecting of minerals and fossils around the city. Two of these gentlemen, Messrs Wm. McIntosh and A. Gordon Leavitt, in their quest have visited the localities for fossil plants, which some forty years ago yielded a rich flora of Devonian age to the labors of former members of our Society, and have been fortunate in discovering some new plants in the Dadoxylon Sandstone. The plants described in this paper were taken by them from beds about 200 feet below the summit of these sandstones, and therefore that distance below the prolific measures of the Lower Cordaite shales which had been worked by myself and the late Professor C. F. Hartt, and at a later date by Mr. W. J. Wilson.

I shall first describe a very interesting form obtained by Mr. McIntosh.

### Pseudobaiera, n. gen. Pl. VIII.

This genus is represented by certain thick smooth leaves which in appearance and structure combine the characters of Filicales and Ginkgoales. The leathery leaves having strap like lobes, ending in mucronate points recall Baiera, while the general port of the plant is that of a fern.

The frond is tripinnate and seems related to Eremopteris, and Triphyllopteris. It is regularly alternately pinnate, the pinnules deeply cleft into strap-like lobes, which lobes also are alternately pinnate and decurrent on the mid-rib. Venation obscure, owing to the thickness and smooth surface of the pinnules.

In the fertile pinnules the lobes are replaced by obovate sporangia or seed vessels, alternately pinnate as in the barren frond, and becoming smaller toward the end of the pinnule.

The plant representing this genus has a general resemblance to *Cyclopteris dissecta,* Goepp. (Sphenopteridium)*, as well as to *Eremopteris* of Schimper; but both these forms are bifurcate in the rachis, have more numerous veins and a more flabellate pinnule—It differs from *Sphenopteris* in the broad flat pinnules and absence of a prominent nerve in the lobes. From *Hymenophyllites* by the absence of alation on the rachis and its sub-divisions.

The fruitage may be compared with *Palaeopteris,* expect that the pedicelled group of reproductive bodies of the fertile pinnules of that fern, are replaced by a single sporangia or pod-like body in this genus.

PSEUDOBAIERA MCINTOSHI n. sp. Pl. VIII. figs. 1 to 6.

The species is represented by incomplete fronds.

The rachis is smooth but has longitudinal shallow furrows. Attached to it are pinnæ the rachis of which has a somewhat scabrous, undulate surface, and shows when decorticated a number of vascular bundles.

The pinnules are set on this rachis about half an inch apart on each side and at an angle of about 50° to 70°; they are long-oval in form, are about an inch and a half to two inches long and are about three-quarters of an inch broad, and are slightly arched forward in the outer half. They are deeply incised into about five long narrow lobes on each side and a terminal lobe; the side lobes are directed forward at the ends and are decurrent on the mid-rib; the lobes are alternately pinnate, slightly arched forward, have nearly parallel sides, and are truncate-lacineate at the ends, where there are from three to five mucronate points; in the lateral pinnules the first two lobes on the upper side are frequently united for one-half their length. The pinnules are thick and

* Zittel's Palæontology Vol. III, Plants, p. 108.

smooth and the venation quite obscure, except near the end of the lobes, where from three to five veins can be made out, one vein running to each mucronate point; decorticated examples show several parallel nerves about the middle of the leaf.

The fertile pinnules are of smaller size and bear alternately pinnate, spatulate-oval, (hollow?) pod-like bodies or sporangia; in the examples known these bodies do not extend to the base of the pinnule, but there are one or two barren strap-like lobes. This pinnule is about an inch and a half long and half an inch wide and shows about four spatulate lobes on each side. These spatulate lobes show a branched venation and possibly held seed vessels which became detached.

From the number of detached pinnules of this species found scattered on layers of the shale it seems probable that the plant had a deciduous habit.

*Horizon* and *Locality*. This plant was collected from a thin bed of shale about 200 feet below the summit of the Dadoxylon sandstone by Mr. Wm. McIntosh, at Duck Cove, Lancaster, N. B.—Not rare.

The resemblance of this plant in its mode of branching etc., to *Baiera* may be seen by comparing its narrow, upright, pinnate lobes to the lobes of the leaves of Baiera; compare also the alternate pod-like fruit.*

The following plants were found to occur with this species— A species of Cordaites is quite abundant. It is probably a variety of *Cordaites Robbii,* Dn, but the Cardiocarpus which occurs with it is smaller and less fleshy than *Cardiocarpus cornutus* of the Lower Cordaite shales. Two abundant plants are an Asterocalamites allied to *A. scorbiculatus,* Schoth. and Calamites *cf.* C. *Cistii.* And C. *cf.* *Suckovii* also occurs but it is not nearly so plentiful. The remains of these four plants according to Mr. McIntosh comprise three-quarters of the collection made by him from this bed.

Remains of ferns are rarer. There is an Alethopteris differing from *A. discrepans,* Dn, the common species of the Lower Cordaite

* See Zittel's Palæontology Vol. III Plants,, p. 253.

shale. A Neuropteris occurs which is not *N. polymorpha*, Dn., so abundant in the higher measures. An obscure Sphenopteris and two forms of Pinnularia (one is *P. dispalans*, Dn.) occur.

In consequence of the coarseness of the matrix it is difficult to read the intimate characters of these ferns, but it is evident that the flora occurring with Pseudobaiera was somewhat varied.

Mutation FLABELLATA, n. mut Pl. VIII. fig. 7.

In this form the pinnules were somewhat more than half an inch apart on the side of the rachis. The pinnules appear to have been about one and a half inches long and were about three-quarters of an inch wide; they were thinner than in the typical form and the lobes more spreading; also the ends of the lobes were more frequently and more deeply gashed; the veins also are more readily seen.

*Horizon* and *Locality*.—Found in Plant Bed No. 2 of Hartt's series.—Scarce.

I have had this form in my collection for many years, but thought it too imperfect for description. It is now clearly seen to be related to the plant discovered by Mr. McIntosh.

## ANNULARIA Brongn.

Not far above the bed containing Pseudobaiera Mr. Leavitt discovered a fine example of a plant of this genus. It may be referred to Brongniart's.

### ANNULARIA LONGIFOLIA.

As a variety or mutation under the name of

mutation LEAVITTI, n. mut, Pl. IX.

Stem about 3 mm. wide. Length between the internodes 30-37 mm.; about 24 leaves in a whorl; length of leaves 30-50 mm.; width 3-6 mm.; there is a strong mid-rib and a slender pointed tip.

**Annularia longifolia, Brgt. mut. Leavitti.**

This form may be compared with *Annularia longifolia* Brongt, as figured by Feistmantel.* The leaves are of about the same length but are in some cases twice as wide, the length between the internodes is also considerably greater. It is also similar to *A. longifolia* Brong. as figured by Lesquereaux.

R. Kidston makes *A. longifolia,* Brong. a synonym of *A. (Casurainites) stellata,* Schlotheim; and in this he is followed by David White; the latter author figures as *A. stellata* a much smaller form than this I have described; and under the synonym, includes *A. longifolia,* Brong.; his *A. stellata* for size agrees with Dawson's *A. latifolia;* now I have collected Dawson's species in large numbers in the Lower Cordaite shale, but never saw one comparable in size with the mutation *Leavitti;* hence, and for the reason that it occurs at a different horizon from Dawson's form, I must regard it as a different species from Dawson's, though only a mutation of the great Annularia of the Coal measures.

*Horizon* and *Locality*. From a thin seam of shale in the Dadoxylon sandstone, a little above the Pseudobaiera bed. Duck Cove, Lancaster, N. B. Found by Mr. A. G. Leavitt.

At page 516 of Sir William J. Dawson's Acadian Geology Professor C. F. Hartt has given a section of the strata at the "Fern Ledges" on the Bay Shore in which he gives the Dadoxylon Sandstone an assumed thickness of 300 feet. Considering this as the thickness of these sandstones at Duck Cove, the following would be the relative position of the beds containing the fossils above described to the section studied by Professor Hartt.

| | Fe |
|---|---|
| Dadoxylon sandstone below the plants above described about | 88 |
| Dadoxylon sandstone including the seams carrying these plants | 12 |
| Dadoxylon sandstone above these beds about | 200 |
| Lower cordaite shales (part), containing Hartt's plant beds | 140 |
| | 440 |

* Zittel's Palæontology Vol. III (Plants), p. 162.

## DESCRIPTION OF THE PLATES.

### PLATE VIII.

Fig. 1. *Pseudobaiera McIntoshi*, n sp.—A pinna with three barren pinnules attached, and two detached.

Fig. 2. The same—A frond with a number of barren pinnules, showing the solidity of the leaf.

Fig. 3. The same—A terminal barren pinnule.

Fig. 4. The same—A lateral barren pinnule.

Fig. 5. The same—A young fertile pinnule with several spatulate lobes and one barren lobe.

Fig. 6. The same—A fertile pinnule with the pod-like sporangia, and two barren lobes at the base.

All figures of the natural size—From the Dadoxylon sandstone, Duck Cove, Lancaster, N. B.

Fig. 7. mut. *flabellata*, n, mut.—Portions of two barren pinnules—Natural size—From the Lower Cordaite Shales. Fern Ledges. Lancaster, N. B.

### PLATE IX.

*Annularia longifolia*, Brngt. mut. *Leavitti*, n. mut.—Stem with four whorls of leaves. Natural size—From the Dadoxylon Sandstone, Duck Cove, Lancaster, N. B.

ARTICLE II.

# REMARKS ON THE HYDROGRAPHY OF NEW BRUNSWICK.

By Joseph Whitman Bailey.

Read June 6, 1905.

In view of the careful hydrographic surveys of New England made in recent years by the United States Geological Survey, it is noteworthy that New Brunswick, which affords a most interesting field in this respect, has received scant attention. The questions involved have at least as much economic as scientific value.

A noticeable general feature is that quick-flowing rivers of the southerly portion of the Province become so low in the late summer that navigation, even by canoe, is difficult or impossible, while nearly all rivers of the northern part, indeed many mere brooks, contain a quite copious flow of water. A general division line between the two classes may be taken as following the valley of the Southwest Miramichi up to the forks, and thence striking across country to Andover. While the Nerepis, for instance, may be nearly if not quite dry above the "deadwater" near its mouth, the Indian freely poles his loaded canoe up the Quisibis or Gounamitz, streams of no greater hydrographic area. The basin of the Magaguadavic at St. George equals, perhaps exceeds, that of the Nepisiquit at its Grand Fal's, but how inferior is the low-water volume of discharge! Upper Garden's Creek, in Prince William, equalling in length some small northern rivers, occasionally becomes quite dry at its mouth, while the Mactaquac and Pokiok make little better showing. Some small southerly brooks at times contain running water in their upper parts, while quite dry below. The writer remembers catching a good string of

trout in the upper reaches of Mill Creek, below Fredericton, although the flow between pools was very small, at a time when the stream bed, near its mouth, was as dry as the railway track which crossed it.

The conditions for copious summer flow apparently do not extend westward from Andover across Maine, as the Aroostook, the main St. John above Allagash, and the Chaudiere River in the Eastern Townships, become astonishingly low at times. Indeed the steady supply of water for power at Grand Falls depends largely on four tributaries of the St. John, the Madawaska, Fish, St. Francis and Allagash Rivers, all of which have large lake expansions in their lower or middle courses, ideally situated to serve as reservoirs. Eastward, in the Gaspe peninsula, those rivers I have seen appear to have a summer discharge disproportionately large for their limited catchment basins.

Many factors contribute to the general features above noted.

1.—The extent of forest. The forests retard evaporation by their shade, and control, by their sponge-like mosses and undergrowth, a too rapid flow of surface water. Forest denudation, principally by fire, has probably been the primary cause of the marked decrease in the summer flow of the St. John, a decrease sufficient to greatly shorten, in the last forty years, the period of steam navigation above Fredericton. A dense growth of spruce, fir and cedar, very common in New Brunswick, is a better protection against drought than a growth of deciduous trees.

2.—Lakes, swamps and "deadwaters". These store up, as reservoirs, the flow of many brooks, producing the more decided effect as they are the more remote from the source of the stream. Madawaska and Fish Rivers are the best local examples. Even the little beaver-dam may be noted in this connection, and the obstruction of fallen trees. The latter often form the nuclei of extensive drift dams, such as "The Big Jam" of the Horton Branch of the Tuladie, which became so long and tangled that the stream-drivers cut a new channel for the river, in preference to undertaking its removal.

3.—The condition and character of the soil as affecting the percolation of water. Obviously a soil allowing free percolation

to a stream after rain may have the counter effect of absorbing the stream in dry times. While normally, in the case of ancient river valleys, the banks become of finer texture as we descend the stream, due to deposition of the coarser flood-borne material in the more rapid upper reaches and of the lighter silt below, yet small tributaries, when nearing the main stream, are often obliged to assume the torrential character, washing the finer material from their beds, and leaving collections of gravel, loose stones, or even bowlders, into which the attenuated summer flow from above may sink and disappear. Long's Creek, in Kingsclear, presents this appearance, and such conditions may have caused the above noted phenomenon on Mill Creek.

4.—The general geological structure of the region, as bearing on subterranean flowage. It is quite possible that rain water falling on the basin of one river may occasionally sink to a level which carries it under the channel of that river, and into some lower valley, there to appear as springs. Possibly Nepisiquit Lake supplies water to the Little Tobique in this manner.

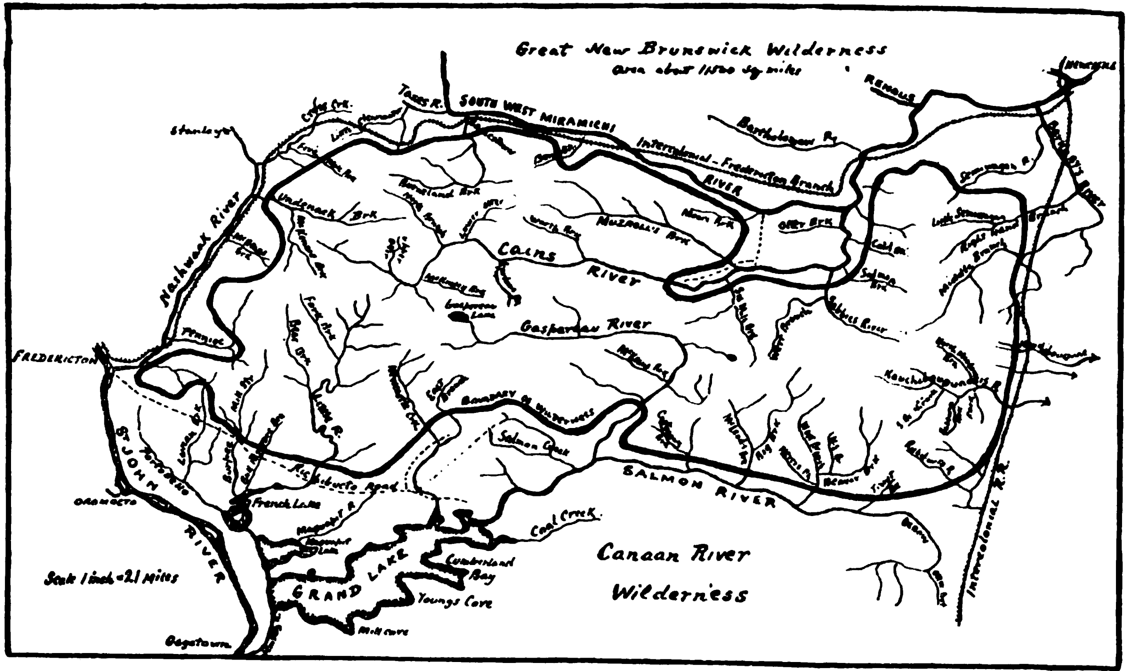
5.—The extent to which a stream is fed by springs as distinct from surface drainage. Conditions in this respect are connected with the two next preceding causes. It seems safe to say that springs are the more numerous in the northern highlands. Spring Lake, the head of the Little Tobique, is the most striking illustration. Its outlet is a wide stream of running water, capable of floating loaded canoes. The navigator virtually sees the source of his river, so far as it is an open visible stream of any size, but a few yards before him. I believe Dr. W. F. Ganong ascertained the temperature of Spring Lake to be only 40° Fah. in August.

6.—The slope of the river valley. In some cases, notably those of the Nepisiquit Little Southwest Miramichi, and Right Hand Branch of the Tobique, lakes and deadwaters near the source offset the unfavorable effect of rapid descent in the lower river. The Northwest Miramichi, although in the region of copious flow, has periods of extreme low water, doubtless owing to its rapid descent and the complete denudation of forest near its main source.

7.—The width of the river channel, as affording exposure for evaporation. Log driving, both in itself and as opening the way for increased erosion by flood water and ice, has materially altered some of our river channels. The writer recalls a large "undriven" brook entering the Serpentine which had not one-fourth the width of neighboring "driven" brooks of apparently equal volume.

8.—The extent and distribution of rain-fall. This is the most important factor of all, and statistics are not obtainable for all parts of the Province. It seems probable that the mean annual rain fall is much the same throughout, and that the streams of the northern highlands are less subjected to droughts than the others, and receive the benefit, in hot weather, of more frequent showers and electric storms. In August, 1904, after a steady twelve-hour rain, a rise took place on Taxes River, altogether out of proportion to that of the Miramichi and neighboring brooks. Our party, taking advantage thereof to pole up seven miles against a murky torrent, was left the following day with merely enough water to carry the canoes back over the sand bars. The gently-sloping well-forested Taxes valley would not point to such conditions. Perhaps some "cloud-burst" occurred over the upper waters.

The various causes above given as affecting the discharge of our rivers may so co-operate or offset each other in a given case that each stream requires separate consideration. In connection with the first important factor, that of forest and swamp, we append two maps, one of the great New Brunswick wilderness, extending into Quebec, which exceeds in area the Maine-Quebec, wilderness by nearly 1000 square miles; and one of the Cain's River wilderness, so called after its principal stream, the second largest area of New Brunswick wild land. The third of such areas in size is that about the head of Canaan River. Large wild tracts also exist in Charlotte County and in Gloucester County, east of the Intercolonial. Smaller tracts are found in all directions. The regions here referred to contain, up to the present year, no railways, no roads, other than those used by lumbermen and hunters, and no permanent human habitations.




Cains River Wilderness

This condition of things, at least as regards railways, will shortly disappear.

The great New Brunswick or northern wilderness, soon to be divided by the railway from Campbellton, contains about 11,500 square miles. The mean elevation is probably about 850 feet, with a maximum elevation of about 2,700 feet at Mount Carleton near Nictor Lake. It has suffered quite severely from fires, especially in the region about the middle Nepisiquit and upper Northwest Miramichi. Some thirty-two of its rivers are more or less navigable by canoe. There are fourteen salmon streams, salmon also ascending a few large brooks.

The Cain's River wilderness, area about 1,500 square miles, is remarkable as extending to within two miles of Fredericton. Its mean elevation will not exceed 250 feet.

The purity of our rivers is affected by inequalities of flow, for where variations are extreme the high floods will cause much erosion and the feeble summer stream will be ineffective in carrying off accidental impurities. The normal impurities of New Brunswick streams may be considered under three heads:—

*First*—Unseen impurities, only determinable by such chemical analysis as has recently been made of the St. John at Fredericton.

*Second*—Such impurities as produce color-effects in the water. This subject has been considered by Dr. Ganong. See Bulletin No. XVI. of the Natural History Society. Here also chemical analysis is necessary to a full understanding. I may add that like contrasts between green and brown rivers draining almost parallel valleys are found to perfection in Gaspe Peninsula, and throughout the Quebec wilderness, and extending at least as far west as Lake Superior. While the great lakes on the St. Lawrence and Richelieu rivers not only act as settling basins, but discharge greenish streams of wholly different appearance from the great majority of their feeders, we observe no such effect with our Fish, Allagash, St. Francis and Madawaska Rivers. We cannot even class these streams among our "clear-waters," and Fish River, which has the greatest lake extent, is probably the darkest of the four.

Some of our wine-colored streams seem to get clearer as they descend. The Nepisiquit is clearer at its beautiful Grand Falls than at the Bogan Pool above, and the rather dark waters of the Wapsky, Odell and Three Brooks have less effect than might be expected on the transparent stream of the lower Tobique. Most of our streams undergo marked color changes, dependant, I think, to a great extent, on the height of the water. Thus the usually green Restigouche, fairest of all our rivers, has been observed by Dr. Ganong to acquire at times the more prevalent brown or amber tint. It seems natural to expect the strongest color in a stream at medium height, when the water is in contact with much vegetable matter in the swamps and low places, and when the volume is not so very great as to diffuse the natural pigments.

*Third*—Ordinary sediment. Obviously such of our streams as have thickly settled valleys are the most highly charged with sediment during floods. It usually produces the color of yellow ochre, and never, I believe, in New Brunswick, that milky white appearance observable in certain streams of the Laurentides. Other forms of sedimentation are mentioned in Dr. Ganong's article. New Brunswick has no waters so heavily silt-laden in summer as those of the Missouri, or even of the lower Ottawa.

On rivers without great lake expansions the principal deposition of silt is usually at their mouth, or marine deltas. Dr. Matthew observes, in a former bulletin of the Society, that the real delta of the St. John is some fifty miles inland. We think no other river in the world has this feature so plainly marked; although, in a less degree, the phenomenon is very common. We may mention the Hudson below Troy and the St. Lawrence at Lake St. Peter, although, in the case of the St. Lawrence, the deposition is really at the delta of the Ottawa, the main stream, above Montreal, being far more free from sediment than any other of the World's great rivers. Inland sediment deposits of this kind seem frequently caused by the submergence and obliteration of ancient deltas by continental subsidences.

A table is added of the approximate drainage areas of all the principal New Brunswick streams, and of their larger tributaries, from which their relative mean annual discharges, but not their

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relative low water discharges, may be reasonably inferred. Lack of accurate topographical surveys of the watersheds makes the results given merely fair approximations, and where, by different calculations, some areas have been found to be about alike, I have recorded them as quite the same, rather than to chance misplacing a river in the series.

It is interesting to note that our Grand Falls discharges the collected waters of about 9100 square miles, an area somewhat larger than Massachusetts, while the St. Maurice at Shawanegan Falls, the site of such recent and extensive economic development, drains about 12,400 square miles, the Ottawa at Chaudiere Falls about 40,000 square miles, Niagara 241,000 square miles. The entire catchment basin of the St. John has been hitherto given at 26,000 square miles, an estimate that several calculations show me to be grossly incorrect. Much the largest hydrographic unit solely in New Brunswick is the system of the Miramichi.

INDEX OF APPROXIMATE HYDROGRAPHIC BASINS OF PRINCIPAL NEW BRUNSWICK RIVERS AND LARGER TRIBUTARIES.

| RIVER | SQ.M. | RIVER. | SQM. |
|---|---|---|---|
| Magaguadavic | 680 | Aroostook | 2160 |
| Miramichi | 4620 | Mesardis | 260 |
| above N. W. Branch | 3975 | Big Machias | 225 |
| above Boiestown | 1090 | Tobique | 1560 |
| N. W. Branch | 1590 | Right Hand Branch | 410 |
| above Little S. W. | 850 | Little Tobique | 370 |
| Renous | 575 | Jemseg | 1470 |
| Cain's | 575 | Maquapit River | 330 |
| Nepisiguit | 800 | Allagash | 1450 |
| at Grand Falls | 600 | Madawaska | 1140 |
| Restigouche | 4740 | Fish River | 950 |
| above Kedgwick | 640 | Kennebecasis | 850 |
| Metapedia | 1430 | Oromocto | 810 |
| Upsalquitch | 910 | Washademoak | 775 |
| Kedgwick | 620 | St. Francis | 700 |
| Patapedia | 300 | Big Black | 600 |
| Petitcodiac (at Moncton) | 600 | Nashwaak | 575 |
| St. Croix | 1630 | N. W. Branch | 550 |
| St. John | 21300 | Green River | 475 |
| above Allagash | 2950 | Meduxnekeag | 420 |
| at Grand Falls | 9100 | Eel River | 230 |
| at Andover | 13200 | Meruimpticook | 200 |
| at Fredericton | 16000 | Miramichi, Little S.W. Branch | 575 |

All these waters are tributary to the St. John River.

## ARTICLE III.

# NOTES ON CAMBRIAN FAUNAS.

By G. F. Matthew, LL.D., F R.S.C.

Read 6 March 1906.

In the Transactions of the Royal Society of Canada will be found a series of short articles on the Cambrian faunas, two of which appeared in the second series, Vol. VIII, Sec. IV, page 93, of that publication. The following is a continuation of that series:

### No. 9.—Ostracoda.

**Bradorna (?) robusta.**—For want of distinctive generic characters this species when described was referred provisionally to Prof. T. Rupert Jones genus Aparchites. At page 461 of the article on the Cambrian Ostracoda of Cape Breton (see Can. Rec. Sci., Vol. VIII, No. 7) we have suggested a possible relation to the species falling under the genus Indiana. The following remarks in this connection may be added.

B. (?) *robusta* in its large size is parallelled by only two of the known forms of the Etcheminian Ostracoda, viz. ***Leperditia*** ?? *rugosa* and *Bradorna perspicator*, mut. *maxima*. It has much of the general outline of the former, but is not so wide in front and has a shorter hinge line; it possesses a similar marked border fold behind. But it is a more ventricose shell and is not wrinkled along the lower side of the shell. This species has a row of somewhat distant tubercles around the ventral curve of the valve a little way off from the margin; this ornamentation was not seen on a specimen from Hanford Brook.

Compared with the second form noted above (mut. ***maxima***) it appears more rounded at the posterior marginal slope, and has a less decided hinge line, this line being shorter and somewhat

Continued on Page 475.

## ARTICLE IV.

# NOTES ON A GRINDSTONE QUARRY AT STONEHAVEN, GLOUCESTER CO.., N. B.

By GEOFFREY STEAD, B. A. C. E.

Read April 4, 1905.

At Stonehaven, about 18 miles east of Bathurst on the south coast of the Bay Chaleur, is a fine quarry where grindstones, scythe stones etc., are manufactured in large quantities. The larger grindstones at least are exported to the States where a single firm uses about 400 per year from this quarry, I believe in the making of large knives, machettas, etc.

The quarry lies below the level of high water and a dam is therefore built around the workings to exclude the sea. All gravel and waste material is then removed from the surface and a bed of good quality stone is left exposed. A channel two or three inches wide is cut through the centre of the top layer of stone and by means then of parallel and perpendicular channels, blocks of the required size are detached.

The first channel must be cut completely through the bed, the parallel and perpendicular channels may be only two or three inches deep when by means of wedges the blocks of stone are split out.

Making the first deep channel is a tedious process as it is done by hand with picks, and on seeing this, I remarked that a chisel or channeller driven by steam would perform the work much more quickly and cheaply. The quarrymen, however, explained that the steam channeller could not be used as it would bind in the cut, for as the channel is made the sides of the rock creep together, the total amount of this movement being about an inch and a half. At times when the channels are being made, the unequal strain coming on parts of the bed not yet cut through, causes large spawls or chips to crack out, thus spoiling many blocks of stone suitable for grindstones.

I thought it interesting that, though in a small way, yet very clearly, a pressure and movement in the earth's crust was here shown to be still in operation, which has during past ages resulted in the crumpling and bending of the earth's crust to form on the one hand mountain ranges with parallel ridges and valleys, and on the other hand elevated plateaus and areas of depression.

About St. John we see evidence of the extreme movement in the upturned and folded strata on which the city rests. That movement has occurred here in comparatively recent times was shown by Dr. G. F. Matthew in describing some faults or displacements in the rocks of the Hospital Hill which must have occurred since the Glacial Period.

The shrinkage, through cooling, of the Earth's mass and consequent settlement of the crust of the Earth, is the primary cause of these movements and it produces great lateral pressure in the rock strata which is noticeable in the movement of the rock in the Stonehaven quarry when the pressure is relieved by cutting through the strata.

In Ohio a level formation is found similar to that in the New Brunswick coal measures and whereas the amount of stone of quality suitable for grindstones is large, it is exceptional to find areas where the beds contain blocks of sufficient size to be used for that purpose.

Where the strata are level and near the surface, the quarrymen claim that they can tell where to look for stone as the ground is generally low and swampy where the most numerous fractures have occurred, and higher and firmer where the best beds may be expected.

At Stonehaven the valuable bed lies with its length parallel to the shore and in an easterly and westerly direction.

The northern side of the bed forms the bottom of, and thins out under, the Bay Chaleur, and thus the pressure here is relieved and, as might be expected, the chief movement is seen when cuts are made across the length of the bed, or in a direction perpendicular to the shore. In other words the pressure upon the sandstones at Stonehaven is only observable as coming from the E. N. E., that is from the direction of the mouth of the Bay Chaleur.

## ARTICLE V.

# NOTES ON THE NATURAL HISTORY AND PHYSIOGRAPHY OF NEW BRUNSWICK.

By W. F. Ganong.

### 89.—On a Remarkable Noise Heard During a Forest Fire at Neguac.

Read January 3, 1905.

While in Tracadie in September last I was told of a remarkable explosion which occurred back of Neguac two years ago in July during a forest fire, and which was supposed to be due to the ignition of gas held in a peat-bog. The information seemed so well substantiated and the phenomenon itself of so unusual a character that I sought further information about it from a prominent and observant resident in the vicinity, one to whom I am indebted for much other valuable information, M. Romain Savoy, of Riviere du Cache. He writes me that the event is well known locally, apparently creating much comment at the time, and that he attempted to investigate the cause, even having the ground examined where it occurred. It was not truly an explosion, but a great roar, lasting about five minutes, and was heard but once. It occurred when a forest fire, driven by a warm southerly wind, was burning with great force in a dense forest. In the meantime a heavy cold easterly wind sprang up, the course of which could be followed by its accompanying clouds. It was when this wind, with its cloud, met the southerly wind and smoke cloud, that the noise was heard; and M. Savoy's explanation, locally accepted, is that it was the meeting of the cold and hot air which in some way produced an effect resulting in the remarkable noise.

## 90.—On the Limits of the Great Fire of Miramichi of 1825.

Read February 7, 1905; later re-written.

Some observations upon the extensive burnt country at the head of the northwest and other branches of the Miramichi, and a desire to determine the rate of reforestation of burnt forest lands in New Brunswick, have led me to attempt to ascertain the precise limits of the great Miramichi fire which occurred in 1825. Two sources of information were obviously available,—first, contemporary records in newspapers, books, maps, etc., and second, the testimony of the age of the timber in the Miramichi valley as known to well-informed lumbermen. The results of both lines of inquiry were the following.

The earliest account of this immense and calamitous fire, (which occurred upon October 7th), that I have been able to find, is dated Miramichi, October 11th, four days after the event. It is a brief but vivid description of the fire, calling attention to the need for aid to the sufferers in whose interest it was printed on the front page of a letter-sheet, evidently intended to be widely circulated with business and other correspondence.* The account of the limits of the fire reads thus:

At Douglastown, "scarcely any kind of property escaped the ravages of the fire.....The Town of Newcastle, with all the surrounding settlements, became a total waste, excepting about fourteen buildings....and four miles through the interior....the greatest desolation took place. The remote settlements from the entrance of the river upwards, present to the eye the dreadful havoc of this most calamitous event, particularly those of the North-West Branch, Baltibog and Nappan, some of which have scarcely a place of habitation left.

Another contemporary account is contained in a pamphlet published in the same year (1825) at Halifax, reprinted, in part at least, in Murdoch's *Nova Scotia* (Vol. III, page 539). It is entirely independent of the Rankin account above quoted, and, so far as the extent of the fire is described, reads thus:

It has since been ascertained that the conflagration extended from the Northward from the neighborhood of Bay Chaleur, where two cottages

* A letter in possession of Mr. Clarence Ward, to whom I am indebted for the use of his copy of the very rare original (recently reprinted in St. John and Miramichi newspapers), shows that it was written by Mr. Alexander Rankin, apparently an eye witness of the fire.

in the forest were consumed, to Richibucto, a distance of 85 miles by land, —and from that place over the whole extent of the Miramichi and its North and South-West Branches, the Baltibogue, Nappan and Black Rivers, and other tributaries, including a tract of more than 100 miles in a direct line, and containing about 8000 square miles of forest in New Brunswick, subject to the ravages of flame and hurricane. In connection with this may be viewed the burning of a great part of the town of Fredericton, the seat of the Government of that province, on the same day that Newcastle suffered, and the fires in the forests of Upper and Lower Canada, and the State of Maine, where the River Penobscot was described as resembling a sea of fire for thirty miles of its course, and the reader may judge of the extent of the injury to the wood, and the ungovernable rapidity with which the flames must have been carried by the winds, to find them at the same period desolating parts of America from Brockville to Miramichi, and from the Saint Lawrence to the Penobscot. In this extensive range of mischief, the sufferings of the parish of Newcastle were far surpassing all the rest in proportion and miserable consequences.

Mr. Clarence Ward has had the great kindness to go systematically through the fyle of the *New Brunswick Courier* for me, from the date of the fire to the end of the year, and later; but while he found full accounts of the fire in other respects, he discovered no definite references to its limits.

The best-known description of the fire, and one practically contemporary, is that by Robert Cooney, published in his *Compendious History* of 1832. He was living at the time, as he tells us, within a mile of Newcastle, and was an eye-witness of all that he so vividly describes. His references to the limits of the fire are as follows:

In Miramichi, and throughout the northern part of New Brunswick, the season had been remarkably dry; scarcely any rain had fallen; and considerable apprehensions were entertained for the crops. Very extensive fires were observed in a north westerly direction; along the south side of the Baie des Chaleurs; in several parts of the District of Gaspe; in the neighborhood of Richibucto, and thence in a southerly direction towards Westmoreland (page 65).....

On the sixth, the fire was evidently approximating to us; at different intervals of this day, fitful blazes and flashes were observed to issue from the different parts of the woods, particularly up the north west, at the rear of Newcastle, in the vicinity of Douglastown and Moorfields; and along the banks of the Bartibog (page 66)....suddenly a lengthened and sullen roar came booming through the forest, and driving a thousand massive

and devouring flames before it. Then Newcastle, and Douglastown, and the whole northern side of the river, extending from Bartibog to the Nashwaak, a distance of more than 100 miles in length, became eveloped in an immense sheet of flame, that spread over nearly 6000 square miles, (page 69) ....the whole cultivated Parish of Ludlow [at the time of the fire including all Blissfield and Blackville] was changed into a waste.... Bartibog, Nappan, Black-River, and several other surrounding settlements became involved in the general ruin. More than four hundred square miles of a once settled country, now exhibited one vast and cheerless panorama of desolation and despair. (page 76).

And once again (on page 70) he implies that the fire covered some 6,000 square miles.

Yet another, and apparently independent account of the fire is contained in M'Gregor's *British America*, published in the same years as Cooney's book (1832). The author had travelled extensively in New Brunswick, though prior to the fire, and he appears to have had some sources of information other than those above cited, though a part of his description shows the wording of the letter of October 11th. As to the fire limits he writes:

In October, 1825, about a hundred and forty miles in extent, and a vast breadth of country on the north, and from sixty to seventy miles on the south side of Miramichi River, became a scene of perhaps the most dreadful conflagration that occurs in the history of the world (Vol. II, 264).

The following account was obtained and printed in the papers for public information a few days afterwards: "More than a hundred miles of the shores of the Miramichi are laid waste, independent of the northwest branch, the Baltibog and the Nappan settlements." . . . (page 266).

Great fires raged about the same time in the forests of the River St. John, which destroyed much property and timber, with the governor's residence, and about eighty private houses at Fredericton. Fires raged also at the same time in the northern parts of the province, as far as the Bay de Chaleur. (Page 268).

Another independent account, giving the recollections of an eye-witness some twenty-four years after the event, is contained in Johnston's *Notes on North America* (published at London, in 1851). The author, while at Chatham in 1849, was told of the fire by a Mr. Rankin, whose recollections of it were very vivid. Traditions and recollections after a quarter-century has elapsed

must always be accepted with caution, but they are not without their value. The account reads thus:

It was an excessively hot summer, and fires were burning in numerous places upon the Miramichi and St. John rivers and their tributaries.... on the 7th of October, it began to blow from the southwest, and the fire to spread over the country in the same direction. The wind increased gradually to a hurricane, and the fire advanced with proportionate rapidity. At one o'clock in the afternoon it was still seventy miles up the river; and in the evening it was at Douglastown. It travelled eighty-five miles in nine hours, so that scarcely on a fleet horse could a man have escaped from it.... the most striking thing that he mentioned were, that the flame as it advanced, was twenty-five miles in breadth; that, coming from the west, it rushed past the towns of Newcastle and Douglastown, leaving a green margin of some miles in breadth between its southern edge and the river; and that when, in its easterly course, it reached Burnt-church River, the wind lulled, turned around and drove the fire up the river again. It then came back along the green fringe it had left as it descended, and by the way licked up the towns of Douglastown and Newcastle..... The town of Chatham on the opposite side of the river, in a great measure escaped, but the Nassua [misprint for Nappan] settlement, six miles behind was burned to the ground. (Page 35).

Still another account, resting apparently upon recollections of Sir Howard Douglas, who visited Miramichi a few days after the great fire, is contained in Fullom's *Life of Sir Howard Douglas* (London, 1863). This work gives also a full account of the fires at and near Fredericton, and estimates the extent of the conflagration as 6,000 square miles.

So much for the accounts proceeding from eye-witnesses or others in a position to know the limits of the fire. Later accounts, if compiled with a genuine regard for the truth, have also their value. Thus the valuable book, *Notitia of New Brunswick,* published in St. John in 1838 (page 126), makes the fire cover an extent of one hundred miles along the Miramichi, by eighty-five in breadth, covering a surface of nearly 8,000 square miles. This work tells also of the fire at Fredericton, and of others on the Oromocto and on the Tobique. Gesner, the geologist, who had travelled over much of this country, makes the extent of the fire from the Nashwaak to the Bartibog, a distance of more than one hundred miles, and even makes it continuous with a fire on

the Tobique, which is probably incorrect (*New Brunswick*, 192).

Again Alexander Monro, the surveyor, in his *New Brunswick*, 1855, gives an account of the Province largely independent of other works, and describes the limits of the fire, which he says embraced;—

Almost the entire country, from within a short distance of the Gulf shore, and the head of the Tabusintac river, thence nearly to the Falls of the Nipissiquit, and from that vicinity in the direction of the Tobique River, and near to its head, and in another direction, beginning at the mouth of the Miramichi River, embracing both its banks, and extending, in some places, beyond the present limits of the county to the Nashwaak river, in the county of York, thus comprehending in the whole, nearly 4,000,000 acres of the best lumbering region of the Province. (Page 202)

Evidence from tradition still current is of course of no great value after so long an interval, (now eighty years) since the fire, but still it is not without use. A valued correspondent of mine, Mr. P. H. Welch of Fulton Brook, Queens County, who has long known the woods of south central New Brunswick as lumber-scaler and through other occupations, writes me that he always understood the fire covered about 5,000 square miles. He also adds:—

About forty years ago I worked with a man, an ox teamster, who was an eye-witness of the burning [of Miramichi], and worked all over the Miramichi afterwards, and he positively stated that it [the fire] commenced a short distance east of Nashwaksis and burned everything but swamps to the Gulf of St. Lawrence, or, to be more correct, to Tracadie Beach.

Mr. Welch also calls my attention to the words of the Ballad of the Miramichi Fire, composed at the time, and still sung by the lumbermen, one line of which runs "46 miles by 100 this awful fire did extend".

So much for evidence as to the general limits of the fire. We consider next what evidence may be found as to its actual occurrence in particular places aside from Newcastle Parish. Its occurrence back of Chatham, though Chatham itself esceped, has already been noted. Mr. Welch confirms this from the relation of his friend the ox teamster, who told him that a spur "crossed

the main river below Chatham and laid everything waste on the south side of the river to Bay du Vin". He also was told by him that "one wing of the fire crossed the southwest river and ran towards Gaspereau burning itself out south of Blackville". Mr. Welch adds that there is other evidence of its extension in that direction, and he has given me the limits shown on the accompanying map. Mr. Welch's statements on this point receive very satisfactory confirmation from another source. In 1844 Sir James Alexander made a survey for a military road from Moncton to Boiestown, and described his observations in his book *L' Acadie* published in London in 1849. In reference to a badly burned district he had to cross between Gaspereau and Cains River, he writes:—

> We had reached the scene of the Great Miramichi Fire of 1825, when the country was ravaged and laid waste from the neighborhood of Bay Chaleur to Fredericton (II, 1849).

And the matter receives confirmation from yet another source, for Deputy Surveyor Fairweather's plan of this country, made in 1836, (for the opportunity to see which I am indebted to Mr. E. Hutchison of Douglastown), shows that all this country between the Miramichi and the Gaspereau had been heavily burnt, though of course the evidence is not conclusive that this fire was contemporaneous with the Great Fire. Alexander's statement, resting as it no doubt did upon the testimony of some of the men in his employ, would seem, however, to make this clear. The extension of the fire in another direction is shown on one of the plans in the Crown Land Office which marks "Outline of Great Fire, 1825", between Mullins Stream and South Branch Sevogle. Through Mr. Hutchison I learn from Mr. Loggie of the Crown Land Office that there is no other evidence in that office bearing upon the present question.

So much for the evidence documentary and traditional. We consider next the evidence from other sources. Seeking such, it occurred to me that an observant and well-informed lumberman thoroughly acquainted with the Miramichi country, would probably know, in part from the ages of the trees growing there,

the approximate limits of the great fire. Accordingly I wrote Mr. E. Hutchison, of Douglastown, well-known as one of the leading lumbermen of the Miramichi, and placed my problem before him. He has had the kindness to reply fully. He gives it as his opinion that the extent of the fire has commonly been exaggerated; that Derby, for instance, was partially, if at all, burned, and that the limits of the fire were about from Portage River south to the main Miramichi, and from the Square Forks of Sevogle east to Bartibog, with a tongue to near Grande Dune.

His evidence is derived from the relative ages of the timber trees cut within and without those limits. When I called his attention to the positive statements of Cooney, seeming to show a much greater extent for the fire, he replied that he was aware of this discrepancy, but that his judgement was based upon the unassailable testimony of the age of trees standing on the areas in question, and that, while the matter is somewhat complicated by the occurrence of local fires, it is possible to trace the limits of the Great Fire with some accuracy in this way.

He called attention to the well-known fact that Chatham was not burnt, and adds that the occurence of abundant and large old logs all along the south side of the Miramichi, including Cains River, Barnaby River, Black River, and Napan, show that there could have been no extensive fires at that time south of the Miramichi, and that if the great fire did cross the river at all, it must have been only locally and without doing any material damage to the woods.

Further, since much of Derby, together with the basin of the Renous, Dungarvon, and Bartholomews Rivers have all produced immense quantities of logs much older than could have grown since the great fire, there could have been no extensive burning in that region as Cooney implies. The same is true of the district east of the Bartibog.

With reference to the age of these logs he adds. "Black spruce, which is our principal export, does not make logs fit to cut much under 100 years, and I have counted 265 rings on a black spruce. The white spruce and pine grow quite twice as fast."

We attempt now to deduce from the collective evidence the limits of the Great Fire. At first sight the testimony appears somewhat conflicting, but this, I believe, is because two quite distinct ideas are associated with the name Great Fire of Miramichi. It seems plain that in early October, 1825, a large number of local forest fires were burning here and there over an extensive drought-stricken country, which embraced a great triangle with its apex near Fredericton, and its base on a line drawn from Belledune to Richibucto, (compare the accompanying map), some 6,000 to 8,000 square miles in area. The great northwesterly hurricane of the seventh of October fanned these fires to greater violence, extending and sometimes uniting them, so that they formed irregular patches and net-works scattered over the area, leaving however, very extensive tracts, especially in the river valleys, entirely unburnt. It is this general fire, or series of fires, to which the name Great Fire is sometimes applied. In certain special sections, however, the fires were of special violence and extent. This was the case with that which burnt the Cains River-Gaspereau region, and with those which burnt the great area, still barren, on the head of the Little Southwest Miramichi, the Sevogle, Northwest Miramichi and Nepisiguit, the most extensive area still open from burning in New Brunswick.* Most important of all these areas, however, partly because of the extent and violence of this particular fire, and partly because it involved so great a destruction of life and property, was that embracing the parish of Newcastle and vicinity, some 400 square miles in area, extending from the Square Forks of Sevogle and Mullins Stream easterly to the Bartibog, and beyond in a narrow tongue to near Grand Dune, and from Tomogonops and Portage River south to the Miramichi, which it crossed below Chatham to

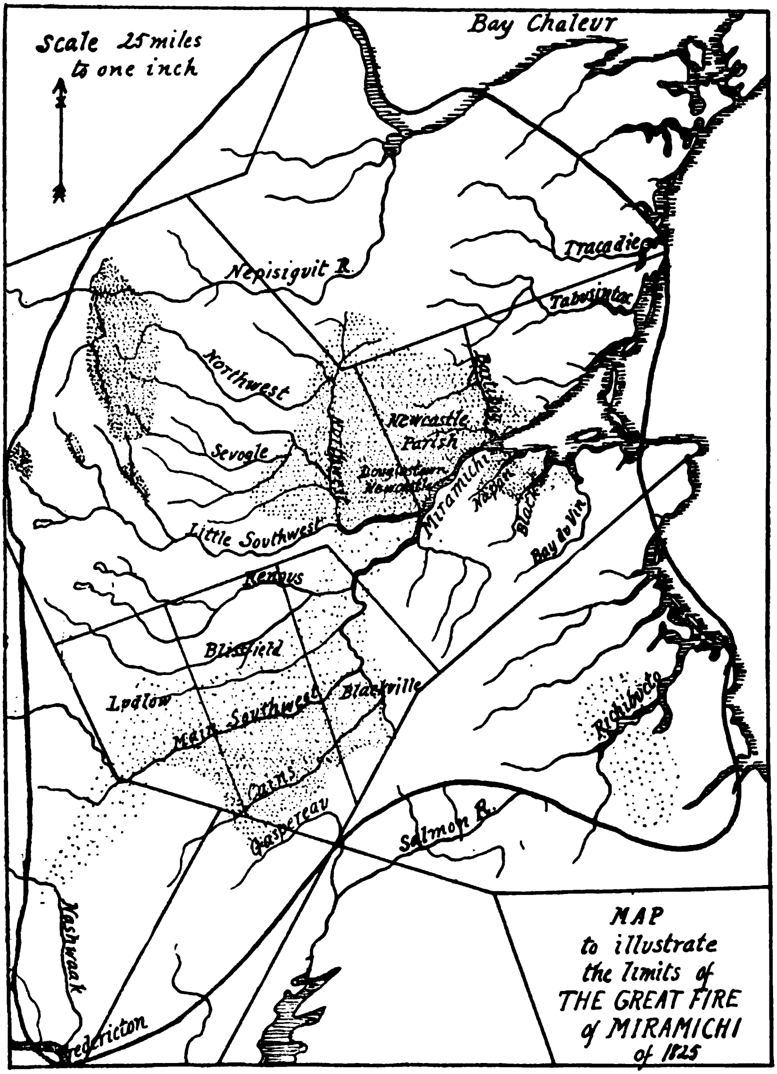
*It is of course not certain that this area was burned at that time, but certainly it was burned a very long time ago, and apparently no more recently than the country about the Square Forks of Sevogle, known to have been burned in 1825. Confirmatory of it are the various references, in the works cited, to the extension of the fire to, or towards Tobique. Perhaps at this time also the Graham Plains and Mitchell Plains country was burned on the Walkemik Branch (Note 87), as well as the burnt country on the North Pole Branch and the Lower North Branch.

devastate Napan and even Black River, though possibly the fires south of the river originated separately. It is this special fire which is also called the Great Fire of Miramichi. If we keep in mind this double use of the name Great Fire, the subject of the limits become fairly plain.

## 91. On a New Contour Map of New Brunswick.

Read March 7, 1905.

Up to the present time no contour map of the Province has been published. Nor, indeed, has any portion of it been thus mapped, excepting only the peninsula between Oak Bay and the St. Croix, which is mapped, with contours, on a United States chart, (see Note 14), the lower St. John valley which is thus represented on a crude steamboat circular, and certain small sections of interior New Brunswick thus mapped in the present volume of this Bulletin (pp. 216, 334). Also a single 200 of 220 foot contour is represented upon the Surface Geology maps. But otherwise vertical topography is shown on our published maps only by occasional and approximate hachures. Of manuscript maps I know but two showing contours,—Owen's fine map of 1841-43, showing the St. John from its mouth to Springhill, and a map of the Province which Colonel Maunsell tells me he made some years ago and sent with a report to the Militia Department at Ottawa. The latter map, I learn on inquiry at the Department, is in its possession, though its authorship is unknown, while the Report cannot be found. At length, however, the first published contour map of the Province has appeared. It is in the latest volume of the Transactions of the Royal Society of Canada (Vol. X., 1904), illustrating a paper of my own upon the causes determining the distribution of settlements in New Brunswick. It is on the scale of sixteen miles to an inch, and the contour intervals are 100 feet. It is constructed (a) from all accessible railway levels, (b) from all barometric measurements that have been published, (c) from my own observations in various parts of the Province, (d) from probabilities based on the




The heavy line indicates the area within which were the local fires often collectively grouped together as the Great Fire. The shaded places show known areas of fire, the definiteness and destructiveness being indicted by depth of shading. The Newcastle-Northwest area shows the extent of the Great Fire proper.

geological or physiographic construction of the country. Of course it cannot be accurate in details, and for two reasons. First, the data are wholly insufficient as yet for a fully accurate map; and second, the scale is too small to allow correctness in limited areas of much diversity. For example, the scale is much too small to allow the topography south of Nictor Lake to be shown as accurately as we know it; and this is true in many other places. Nevertheless, the map, I think, gives a correct idea of the general contours of New Brunswick.

## 92. THE FACT BASIS OF THE FIRE (OR PHANTOM) SHIP OF BAY CHALEUR.

Read April, 4, 1905; re-written Jan 1906.

One cannot be long in the Bay Chaleur country, especially its eastern part, without hearing of the fire (or phantom) ship, said often to be seen on the bay. Until a short time ago I regarded the fire-ship as a pure fiction, with no basis other than the proneness of humanity to see wonders where they are expected, or where others say they exist. But as a result of two visits to that country, during which I questioned many residents on the subject, I have had to change my opinion; and I now believe there is really some natural phenomenon in that region which manifests itself in such a way as to be imaginable as a vessel on fire.

First we note the literature of the subject. Naturally the imaginative writers who have visited Bay Chaleur have seized upon the story of the fire-ship as a rare treasure, and, adding to the wildest local tales sundry fanciful imaginings of their own, with embellishments of banshees, pirates or picturesque historical personages, have produced weird fantasies such as are preferred to truth even by grown-up persons. A type of such stories is found in Miss E. B. Chase's *Quest of the Quaint* (Philadelphia, 1902), which connects the ship with the voyages of the Cortereals, making it a vessel set on fire by one of them when attacked by the Indians. From such a treatment there is every gradation, through many newspaper, guide-book and other accounts up to

serious descriptions of the phenomenon as something with a probable fact basis. The best account of the latter type that I have seen, written apparently by Mr. A. M. Belding, appeared some years ago in the St. John *Sun*. It reads in part as follows;—

> The extent to which a visitor may be impressed by the story of the phantom ship depends a good deal on the source of the information. Hon. Robert Young [of Caraquet] will tell you, for example, that frequently at night before a storm a large light may be seen on the surface of the bay. It may be seen in winter, when the ice has formed, as well as in summer, and it is not confined to any one portion of the bay. Sometimes it is much brighter than at other times and appears to dance along the surface. Joseph Poirier said he had seen it so bright that the reflection would appear on the houses at Grande Anse. Rev. Father Allard said he had seen it several times this season. In fact it appears to be quite a common phenomenon, though nobody is able to explain its cause..... Those who decline to place full reliance in this interesting story [viz. the fanciful legend] nevertheless admit that sometimes the mysterious light emits rays that shoot into and athwart the gloom, and might by a particularly well-nourished imagination be likened to the flame-lit rigging of a ship.

The information I have myself been able to collect from those who have seen the light is as follows. Of course I have sifted all testimony to the best of my ability, eliminating all exaggerations and embellishments, whether these be due to the habit of all humanity to make a story as big and good as possible, or to the common tendency to gull an impressionable stranger, or to mere ignorance, superstition or mendacity.

Four years ago Captain Turner of Riverside, Albert County, a clear-headed sea captain, told me, in answer to my mention of the fire-ship as a freak of the imagination, that he had himself seen it and hence knew it to exist. Later, on my first visit to Caraquet, I was told by a lady in whose word I have absolute confidence, that her attention was attracted one night by a light off Caraquet, which looked so much like a vessel afire that she supposed it to be one of her husband's schooners, and called him in alarm, only to find that it was the fire-ship. A prominent resident of Miscou, Mr. James Harper, told me he has seen it but once, in the winter on the ice off Clifton. It was seemingly some

ten miles away and kept rising and falling, dying down to a very small scarcely visible flame, then rising slowly into a column "looking thirty feet high." It was not in the form of a ship, but a column, but people told him it was the fire ship. He was told it preceded a storm, but he took notice and no storm followed. Mr. Robert Wilson of Miscou, who sails much on Bay Chaleur tells me he has seen the fire-ship, (or as he calls it, the "burning ship") several times. The time he was nearest it was about eleven years ago off Caraquet on a very dark night. The light appeared ahead, and finally he came near and passed within 100 yards to windward of it, so that he saw it with perfect clearness. It was somewhat the shape of a half-moon resting on the water, flat side down, or like a vessel on the water with a bowsprit but no masts etc., and "all glowing like a hot coal." He dared not run nearer and passed it, keeping his eyes upon it until far beyond. On other occasions he has seen it, at various distances, and has come to pay little attention to it. Sometimes it looked somewhat like a ship, sometimes not, and sometimes it vanished while he was watching it. Usually it is dancing or vibrating. Again he has seen it as one tall light which would settle down and rise again as three, which would again settle, and so on. Recently I have been told by Dr. J. Orne Green of Boston, whose connection with Miscou is mentioned below, that Mr. Wilson reports seeing the light this (1905) autumn; it appeared ahead of his boat as he sailed up the bay, vanished as he neared it, and in a few minutes re-appeared astern. Mr. Andrew Wilson, another leading resident of Miscou has also seen it, when it resembled a whaleboat, not a ship, in form. Mr. McConnell, keeper of the light at Miscou Gulley, tells me that he has seen the fire-ship, about two miles away, but it did not look to him like a ship, but more like a big bonfire. Several others have told me that they have seen it, (the great majority of the residents in the region averring that they have seen it at one time or another), most of them agreeing that at times it looks like a ship on fire, but that at others more like a round light. All agree that it usually precedes a storm, and is seen over the ice in winter as well as over the water in summer. On the other hand, other trustworthy residents of

Miscou, notably Mr. Jas. Bruno and Mr. Ed. Vibert, both of whom sail much on the bay, tell me they have never seen it, and do not believe in its existence.

So much for local testimony. But it receives confirmation from another source. For many years past Dr. J. Orne Green of Boston, a Professor in the Harvard Medical School, has spent several weeks on Miscou and has taken a great interest in all that relates to the region. He tells me that he has himself seen a light which he was told was the fire-ship. Many years ago when running at night towards Caraquet he saw a fire off in the bay, and called the attention of his companions to it, but finally thought it must be a woods fire on the north side of the bay. Reaching Caraquet, however, he found the people excited, because they said the fire-ship was out in the bay. He told them of his belief that it was a woods fire, but they declared this could not be, because it had moved. The wind at the time was gentle, from the southwest, but it was followed the next day by a great northwester. His interest being thus aroused Dr. Green, in later years, attempted to investigate the phenomenon. He found that it was reported not only in Bay Chaleur but also in the Gulf of St. Lawrence as far south as Northumberland Straits. He came to the conclusion that while the stories were mostly exaggerated and distorted there was nevertheless some basis for them in fact, and that there does occur in this region some natural light of the general nature of "St. Elmo's Fire." This was exactly the conclusion to which I had come independently, as stated in this note when originally read before this Society.

Grouping together all the evidence it seems plain,—*first,* that a physical light is frequently seen over the waters of Bay Chaleur and vicinity; *second,* that it occurs at all seasons, or at least in winter as well as in summer; *third,* that it usually precedes a storm; *fourth,* that its usual form is roughly hemispherical with the flat side to the water, and that at times it simply glows without much change of form, but that at other times it rises into slender moving columns, giving rise to an appearance capable of interpretation as the flaming rigging of a ship, its vibrating and

dancing movements increasing the illusion; *fifth,* its origin is probably electrical, and it is very likely a phase of the phenomenon known to sailors as *St. Elmo's Fire.*

I have, of course made efforts to ascertain if any such phenomenon is known elsewhere in the world. Professor R. De C. Ward, Assistant Professor of Climatology in Harvard University, writes me that he knows of no record of a similar phenomenon, and no development of St. Elmo's Fire so great that it could be mistaken for a burning ship. Professor A. H. Pierce, my companion in my visit to this region last summer, has, however, called my attention to references to an allied subject in the Journal of the Society for Psychical Research, XII, 1905, 108, and again in the Proceedings of the same Society, XIX, 1905, 80, where an account is given of lights claimed to have been seen around Tremadoc Bay in Wales; but the conclusion is reached that in all probability they have only a subjective basis, though the statement is also made that lights of unexplained origin were reported as common on the Welsh Coast over two hundred years ago. It is also of interest to note that Schmitt's newly-published Monographie de l'Isle d' Anticosti (57) mentions manifestations of St. Elmo's Fire observed at that Island.

It is plain that in this phenomenon we have a subject which invites accurate investigation. It can best be studied by a scientifically-trained person, a physician or other student accustomed to scientific evidence, resident at Caraquet or Grande Anse.

## 93. THE ORIGIN OF THE NORTHUMBRIAN SYSTEM OF RIVERS

Read in abstract May 2, 1905.

The most striking physical feature of New Brunswick consists in its abundant great rivers. These are, however, so diverse in direction, and interlock so complexly as to make the elucidation of their origin seem well-nigh hopeless. But prolonged study is showing that in reality they are derived from three primal systems, a Fundian system which I have described in an earlier note (No. 75), a Northumbrian System, which is here considered,

and a Laurentian System on which I hope soon to make some observations before this Society. I need hardly emphasize that the present paper is by no means final in its conclusions; like its predecessor it is rather intended as an organization of the available facts, and for the formulation of an hypothesis to serve as a guide for further study.

The system I call the Northumbrian (because lying principally in Northumberland County or else tributary to Northumberland Straits), includes all the rivers emptying into the Gulf of St. Lawrence from Bay Chaleur (but excluding the Restigouche) to Baie Verte, together with certain branches of the lower St. John which belong morphologically with them.

Viewing the system as a whole, we find that its valleys present certain resemblances and certain differences, the latter being marked enough to make it natural to consider them in some four groups, each distinguished by peculiarities of topography. By far the largest part of the system falls within the limits of the great central-eastern Carboniferous Basin of the province, a low plateau country having a gentle easterly slope and formed of soft undisturbed Carboniferous sandstones. It is in this basin that the rivers all have that parallel southwest-to-northeast course which is so characteristic, while the deviations from this direction are determined by the crystalline highlands either on the northwest or the south of the basin. But we can best consider the valleys in groups.

The first group of Northumbrian valleys embraces those from Shediac to Baie Verte, and extending thence into Nova Scotia, (compare the accompanying map). This group, however, I wish to reserve for further study, and will merely note here that I believe the original valleys headed in a line of crystalline highlands (an extension of the "Old Eastern Watershed") now represented by the Cobequid Mountains and the highlands of Albert County (this range being now cut completely across by Chignecto Bay). They emptied northeasterly to the present Northumberland Straits and across them and Prince Edward Island to the sea, the many inlets of the Island representing the remnants

of those old valleys. But the group of valleys has been so profoundly modified by the formation of the Bay of Fundy that much careful study will be needed to make its original relations clear.

The second group of valleys, however, is much plainer in its relations. It includes all those from the Petitcodiac-Shediac valley to the Main Southwest Miramichi. They all have this in common, that they lie in parallel courses from southwest to northeast wholly within the limits of the Carboniferous basin while the present rivers mostly head in line with branches of the St. John from which they are separated only by low divides, across which the original valleys no doubt extended. These divides, (the "Present Watershed" of the map), lie in a line running northwest between the Petitcodiac and Shediac, clear to the Main Southwest Miramichi, which it reaches just to the eastward of the remarkable right-angled bends of that river, after which it swings to the north across both branches of the Miramichi and then to the Northeast just east of the Northwest Miramichi (Minaqua) and Nepisiguit. This watershed, throughout its entire course is now crossed by but a single river, the Miramichi. The causes of this curious exception I have discussed in an earlier note (No. 54). In brief it seems due to the presence here of a great synclinal trough, parallel and homologous with the deep trough forming Bay Chaleur, the much shoaler trough in which lie Richibucto and Grand Lake, and the deep trough forming the Bay of Fundy. This watershed is obviously comparatively modern, and as it runs here parallel with the present coast, and hence with Northumberland Straits and with Prince Edward Island, I take it that the three latter all have the same origin, viz., low synclinal and anticlinal foldings parallel with the present seacoast. However formed, this watershed is of profound importance in the development of the Northumbrian Rivers, since it not only beheaded all those of the group we are considering, sending most of their upper courses into the St. John, but also beheaded those of the next group, both south and north of the Miramichi, turning their upper courses northward or southward into the Miramichi itself. But if the present watershed be modern, we

ask where was the ancient one, that which existed when the Northumbrian valleys were first formed? This I believe ran about as described in my Note on the Fundian rivers, namely in a line of hills (the "Old Eastern Watershed"), of which remnants still exist, extending from near Cape Wolf on the Bay of Fundy, northwesterly across the head of Grand Lake, and between the Nashwaak and Taxes to join the Central Highlands. Certainly all the facts known to me in connection with this subject seem to accord with this explanation. The ancient Northumbian valleys, therefore, would have headed on this Old Eastern Watershed; they extended northeastward including some branches of the St. John and all of our present North Shore rivers of this group; while they no doubt in part crossed Northumberland Strait and Prince Edward Island, the inlets of which match well with the continuations of our rivers. Between these valleys are the ancient ridges of erosion, parallel with the valleys, and manifesting themselves on the coast as the various projecting and more or less elevated headlands, some of which can be seen to match with the elevated and wider parts of Prince Edward Island.

We consider now the valleys of this group in order. My explanation of their courses is chiefly based on cartography, supplemented by information from other sources; it is not worked out upon the ground.* But the homologies seem so clear, and all the facts known to me so consistently in agreement, that I have no question as to its correctness in general, though I may be wrong in many details. A careful study on the ground will undoubtedly show the influence of glaciation in modifying details of the river courses, but the greater features of the rivers must depend upon other causes.

1. *The Shedian Valley.* This is the least distinct of the series, but all considerations of homology and cartographical evidence seem to indicate that the present upper part of the Petitcodiac formerly continued its

*In fact this country is all of such low relief, has suffered erosion of its soft rocks for so long a time, and is mostly so densely forested, that the tracing of ancient valleys by other than cartographical evidence will offer great practical difficulties.

course across to Shediac Harbor, (its present lower course being the result of capture by a Fundian river), either by the root followed by the present highway and railway to the southern part of the harbor, or else leaving the present valley below Salisbury and running across south of Indian Mountain to the Shediac River. Its head is of course in the Anagance, which rises on the old eastern watershed, and it may have relations with the Kennebecasis still to be worked out.* Its large southerly branches (which morphologically include the present head of Kennebecasis, or Salmon River), flow from the Southern crystalline Highlands precisely as many branches flow into the same basin from the similar Central Highlands.

2. *The Cocagnian Valley.* Headed in or near the present Bennetts Stream and included the present North River and Cocagne, probably continuing through Egmont Bay across Prince Edward Island.

3. *The Buchtouchian Valley.* Headed in the present Prices Brook, (or perhaps in Thornes Brook), which is strongly re-entrant to the present course of the Canaan, follows the upper course of the Canaan, crosses, (by the general route of the old Indian portage), to the Buctouche, along that river and probably across to Prince Edward Island, emptying through Cascumpec Harbor.

4. *The Richibuctian Valley.* Headed in the present Salmon Creek, which is strongly re-entrant to Salmon River, and included all Salmon River to the old Indian portage, across by its route, and by the Richibucto, and into the Gulf, north of Prince Edward Island.

A minor valley probably existed between this and the preceding, embracing a part of Coal Creek and Lake Stream, the upper part of Salmon River, and emptying by some branch into the Richibucto. Possibly another emptied by the Chockpish.

5. *The Kouchibouguasian Valley.* Headed in the present Gaspereau (captured later by a branch of Salmon River), followed along the course of Meadow Brook, and the extensive line of open barrens (which exist

*Of course, in still earlier times, the river which preceded the Petitcodiac and Anagance headed in the present Kennebecasis, as Dr. Matthew has pointed out in this Bulletin, XII, 54. But that was when the Carboniferous rocks were being laid down in a preceding geological and geographical cycle. As I understand it, all of our present rivers originated in a much later cycle, after all the rock formations of the Province had been laid down and were elevated again above the sea. It was, I believe, on this final elevation that the province possessed that three-plain or three-plateau structure which originated the three primal river systems, the Fundian, Northumbrian and Laurentian, while subsequent geological movements and erosions, supplemented by the glacial period, have altered the originally comparatively simple systems into their present complications.

here as I am informed by Mr. P. H. Welsh), into the Kouchibouguacsis and thence to the sea.

6. *The Kouchibouguian Valley.* Headed in the upper parts of Cains River, (possibly beyond in a part of the upper Nashwaak), crossing to East Branch Sabbies River, thence to the Kouchibouguac and so to the sea. It is likely that another valley headed in Burnt Land Brook, and included Muzeroll's Brook, a part of Cains River and Salmon Brook, and then either entered the Kouchibouguac or else the Vinian Valley.

We consider now the third group of the Northumbrian Rivers, those beginning with the Main Southwest Miramichi and extending to, but not including, the Nepisiguit. I have been able to study personally several of these, with results recorded in previous notes of this series, in one of which (No. 54) I have given an outline (differing somewhat in details from that here presented) of the physiographic history of the Miramichi. These rivers all have these important features in common, that their upper courses are not, as in the preceding group, in the line of their lower courses, but instead they head in the crystalline Central Highlands and flow approximately parallel (though with interrelationships still to be worked out) from northwest to southeast, until, reaching later and softer rocks, they swing by long curves through a right angle, flow for a space across the Carboniferous basin in the characteristic southwest to northeast direction, and then suddenly, although still in the same formation, swing at right angles, some to the north and some to the south, into a single trunk river, leaving their original lower courses to be occupied by much smaller rivers emptying northeastward into the sea. These smaller rivers all turn, near their mouths, towards Miramichi Bay, as a result no doubt of the fact that this Bay lies in a synclinal trough (already mentioned), down the slopes of which the rivers naturally tend to turn. The heads of these rivers in the Highlands, though they have undergone some changes in detail, are, I believe, the original heads, and the old central watershed and the present one are identical, excepting that it is now crossed by the South Branch Nepisiguit and the Main Nepisiguit River, a condition earlier explained (Note 70). The great curves do not occur exactly at the contact of older with

newer strata, but approximately so. The presence of these curves would seem to indicate that the older rivers flowing radially out of the Central Highlands, here met the ancient Carboniferous Plain, which, having an even slope northeast, carried the rivers in that direction, a feature which speaks for a somewhat ancient origin of the system. These curves are not in all cases in their original positions, as I have shown in some of the earlier notes on these rivers, and as the cartography of others seems to imply. The reasons for the remarkable turning of all the lower courses of all these rivers into the single Miramichi are fairly plain and have already been indicated. It is due to the presence of a great north and south depression beginning in Nepisiguit Bay (which owes its existence to it), and running south along the present course of the lower Nepisiguit, Portage River, the Northwest Miramichi, the several right-angled bends of the Main Southwest Miramichi, including Cains River, and perhaps even showing in some of the branches of Salmon River.* This great depression, which is parallel with the watershed just to the eastward of it, and with the sea-coast, is, no doubt, either a shallow syncline or a great fault line, formed in times comparatively recent. The fact that north of the main Miramichi it is occupied by a single valley (which from its Indian name we may call the Minaqua), collecting the streams from the west, while south of the Miramichi it is not a single valley but rather the turning of the streams into one another, is probably due to the fact that the syncline, with its anticline on the east, is less marked to the south and more marked towards the north.

We consider now the valleys in detail. The upper part of the first of them, the Main Southwest Miramichi, and its relations with the Nashwaak and Taxes, are puzzling, and I reserve consideration of them until I have been able to study them upon the ground. Aside from this, however, the courses of most of the valleys are fairly plain.

*Or, continued through the Gaspereau, Grand Lake and the lower St. John, it forms one of the great lineament lines of Eastern North America, discussed by W. H. Hobbs, in the report of the Eighth International Congress, (Washington, 1905, 193).

7. *The Vinan Valley.* Headed in the Taxes, following the Main Southwest to the mouth of Cains River, then by Black Brook and a part of Barnaby River (the waters of the two latter streams coming much closer together than shown upon any printed map, *fide* MS. plans in the Crown Land Office), thence to Bay du Vin River, which apparently formerly emptied through Lower Bay du Vin, as shown on the map.

8. *The Matquantian Valley.*—(from the Indian name, Matquanticook or Black River). Headed in Bartholomews River, (which does not now head in the Highlands, but which further study will probably show to have done so), along Bartholomews, a short reach of the Main Southwest, the Semiwagon and Black River, which emptied south of Vin Island across the present position of Fox Island.

9. *The Napanian Valley.* Headed in the Dungarvon, probably in King Brook (though perhaps in the Upper Tuadook, Note 86) and thence along Dungarvon to the Main Southwest as far as Barnaby River, thence across to the Napan and Miramichi Bay.

10. *The Miramichian Valley.* Headed in the present upper Dungarvon and beyond in the upper waters of Tuadook and Rocky Brook (Note 86), probably across to South Branch Renous, with Branches as shown on the map, and by Renous, and across to the tidal part of the Little Southwest as shown on the map, and thence along the present Miramichi and along the north shore of Miramichi Bay, thus forming the axial river of the system. The complicated relations of the South Branch Renous and Dungarvon are uncertain, and perhaps the headwaters of this valley belong with the present Dungarvon.

Such seems to me the most probable arrangement of these valleys from such data as I have at hand. It is however possible that the arrangement may have been different in detail. Thus a part of Cains River may have run into Bay du Vin River, the Taxes and Main Southwest into Black River, Bartholomews into Napan, Dungarvon forming the axial river. Or the Dungarvon may have flowed by Stewarts Millstream. I have no question whatsoever that a careful study on the ground, or the possession of accurate contour maps of the region, would enable us to settle these questions, at least to a high degree of probability.

11. *The Tuadookian Valley.*—From Tuadook, the Indian name of the Little Southwest Miramichi'. Headed in the Tuadook Lake region, and no doubt in the Walkemik Basin (Note 87), the connection of this basin with the present Little Southwest Miramichi (with a preglacial course through Mains Lake and Brook, Note 54) being much later in origin: followed the North Branch Renous (Note 85), to McKendrick Brook, by

the valley of which it swung to Catamaran Brook and the Little Southwest Miramichi. Its course beyond that it obscure, but the general parallelism, sustained by certain features of the smaller streams, would suggest a continuation of its course parallel with the present north shore of Miramichi Bay to French Cove and thence to the sea through Tabustintac Lagoon.

12. *The Tabustian Valley.* Headed in the North Pole Branch (and probably in its Half Moon Lake branch, Note 99), followed the North Pole Branch across its big bend to near its mouth (Note 54) where its old course was in line with the Little Southwest below, thence along the Little Southwest, bending gently north of its present post-glacial angle (Note 54), thence to opposite Little Sevogle and across to that stream, along it and across country to Green Brook, thence to Stymests Millstream and thence to Portage River and into the sea by the present course of the Tracadie (Note 94).

13. *The Tracadian Valley.* Headed in the South Branch Sevogle and perhaps beyond in the West Branch of the Main South Branch of Nepisiguit (as will be shown in a later note), and with another branch heading in the Lower North Branch (and perhaps beyond in the uppermost course of the present North Pole Branch, Note 99), and following Mullins Stream, across country south of the Square Forks to the Eskedelloc and a part of Tabusintac, across the Tracadie near Head of Tide (Note 94), and by Little Tracadie to the sea near Green Point, (or possibly through South River, Pokemouche).

14. *The Pokemouchian Valley.* Headed in the Main Northwest Miramichi, receiving branches as shown on the map; and by the Main Northwest, the East Branch Portage River, across to a basin near Meadow Brook on the Tracadie (Note 94) and along the Main Pokemouche to St. Simons Inlet and Shippegan Harbor to Bay Chaleur.

15. *The Caraquetian Valley.* Headed in the Tomogonops (and possibly even in a part of the Nepisiguit near Indian Falls), swings to the south branch Portage River, thence to the source of the Tracadie and across to the Caraquet (Note 94) and thence to the sea.

Such seem to me the most probable courses of these ancient valleys, though here again, while believing in the correctness of my explanation in general, I think it likely that considerable error may exist in details. Such an arrangement of ancient valleys would not only bring this whole series of rivers into homology with those in an identical geological formation south of the Miramichi, but at the same time explains the reason for the re-entrant directions of the rivers flowing into the Minaqua River, a feature

otherwise very difficult to explain, and also the reason for the peculiar northeast direction of parts of the Bartibog, Tabusintac, Portage River and Little Tracadie, and for the curious course of the Caraquet parallel with the coast of Bay Chaleur. The correct linking of the valleys east and west of the New Eastern watershed is rendered very difficult by the changes which have been brought about by the considerable height of that watershed (at least 535 feet by railway levels), and also by subsequent changes, in part glacial, in the courses of the Pokemouche, Tracadie (Note 94) and Tabusintac valleys. The lower courses of these streams, no doubt following the slope of the syncline trough forming Miramichi Bay, have been swung directly eastward across the low ridges separating the ancient valleys (compare Note 94). All of the intervening ridges can be traced near the sea;—thus the Tuadookian-Tabusintian ridge shows in the elevation east of Portage River; the Tabusintian-Tracadian in the elevated ridge on which Tracadie Village and its church now stand; the Tracadian-Pokemouchian, the highest and most important of all, extends out to form Shippegan and Miscou in one direction, and southwesterly to cross the Minaquan valley near Chaplins Island, causing there the wide separation of the mouths of the Northwest Miramichi and the Sevogle; the Pokemouchian-Caraquetian comes to the sea in the cliffs of Caraquet; and the Caraquetian-Nepisiguitian (the latter mentioned below) in the cliffs at Grande Anse.

We consider finally the fourth group of these Northumbrian Rivers, including the small rivers north of the Nepisiguit to Bay Chaleur. Though short, they all show the right-angled bends on their issuance from the crystalline highlands, followed by a northeasterly course showing a certain homology with the valleys to the south of them. Then in their lower courses they are swung northward into Bay Chaleur, by the same causes which turned the rivers to the southward into the Minaqua valley, namely the elevation of the New Eastern Watershed immediately on the east. The recognizable valleys are the following;—

16. *The Nepisiguitian Valley.* Headed probably in or near 44-mile Brook, and followed the general course of the present Nepisiguit to below

Grand Falls. Thence, I think, it flowed, parallel with the valleys south of it, across to the Pokeshaw, which now runs in a remarkably trough-valley parallel to the coast.

17. *The Pabineau Valley*. Headed in the upper part of 40-mile Brook, continuing across to Nine-mile Brook, bending in the latter to enter the Pabineau, which perhaps at first crossed to near Salmon Beach, but early formed the lower course of the present Nepisiguit.

Northward of this valley traces of the same arrangement, including the bends (now less marked because these rivers radiate from the highlands rather to the east than the southeast), may be seen in Little River, Middle River, the Tetagouche and others nearly to Belledune. Their lower courses no doubt flowed northeasterly over a plain of Carboniferous rocks now replaced by Bay Chaleur. North of the source of the Tetagouche, however, the crystalline Highlands come to an end, though an extension of them in Silurian rocks forms that notable swelling into Bay Chaleur centering in Belledune. North of Belledune the rivers all belong to the Laurentian system, later to be considered.

## 94. The Physiographic Characteristics of the Tracadie River.

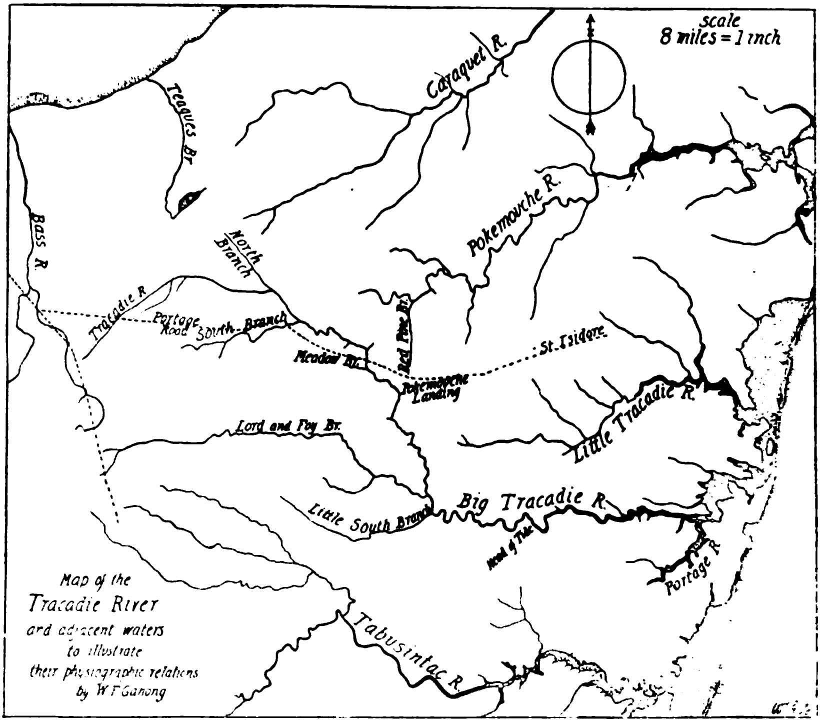
Read December 5, 1905.

In the northeastern section of New Brunswick are several considerable rivers, the Tabusintac, Tracadie, Pokemouche and Caraquet, about which hardly a word is to be found in all our scientific literature. Yet these streams are of great interest, not only for what they actually are, but also for their bearing upon the most important and alluring problem in all the physiography of this province, the mode of evolution of its three great primal river systems. It was therefore with the keenest delight I was able to study the principal one of the series, the Big Tracadie, during a canoe trip* from near its head to its mouth in August

*I was accompanied by my friend, Professor A. H. Pierce. We were portaged from Bathurst via the Bass River and portage roads to the mouth of the South Branch. I discovered too late for a change of plan that we might have descended the river with no great difficulty from near its source, where it crosses the portage road.

last. Such results as I found of interest are recorded below, and are further illustrated on the accompanying map.

The development of our knowledge of the river may be briefly traced. Its name, which perhaps was extended to the river from the region of its mouth by the whites, is Micmac Indian, meaning, probably, "camping-ground," descriptive of the extensive occu-



Map of the Tracadie River and adjacent waters to illustrate their physiographic relations by W F Ganong

pancy of Tracadie by the Indians in early times. It is first mentioned, not as a river but as a place or port, by Champlain in 1604; and thereafter it appears upon substantially all maps down to the present day. No attempt however was made on the early maps to represent the river, except by an occasional crude and conventional sketch, until after it was surveyed in 1838 by David Sadler, whose large-scale plan in the Crown Land Office, show-

ing the river from Portage River nearly to the head of the South Branch (viz. the upper South Branch), is the original of all later published maps down to the present day. The part above the South Branch has never been surveyed, but is simply sketched from intersections of timber-lines; it is represented very badly upon all printed maps, but more accurately upon the timber-plans in the Crown Land Office, from which the accompanying map is taken. The lower course of the river, from three or four miles above Portage River, was only sketched by Sadler, and his imperfect draft is followed on all printed maps. That part is given more correctly from land surveys on plans in the Crown Land office, followed on the accompanying map. The Big Tracadie was not settled until after 1800, though the Tracadie Settlement, at the mouth of the Little Tracadie* is much older. The settlers are almost entirely Acadian French, who have extended slowly up the tideway until now their uppermost pioneer settlements reach to within two miles of the head of tide. All of the remainder of the river is still a wilderness. It has always been noted as a valuable lumber river, and some lumber of the very finest quality is still being taken from its headwaters, though locally it is said to be almost exhausted.

Another notable Tracadie feature, less striking now than formerly, is its wonderful trout-fishery, especially for sea-trout in its lower course. For this reason it has been much visited by sportsmen, and mention of it occurs in several angling books and especially in the Reports and other writings of M. H. Perley. Scientifically however the river seems not at all studied. I can find no mention of it in any scientific writings accessible to me, even the geological reports containing not a single reference to the river.

The Big Tracadie River rises in a tiny spring rivulet close to the Bathurst Road, as I am told by Mr. Frank O'Connor of Bass River, who knows the Tracadie thoroughly, and to whom I am indebted for much important information about it. It flows northeasterly, rapidly enlarging, until at the crossing of the

*The history of the founding of Tracadie, with a large scale map of the mouth of the Big Tracadie, are given in a forthcoming paper by the present writer in Trans. Royal Society of Canada.

portage road (see the map), it is a meadowy stillwater stream, navigable even at low water for a canoe, winding at the bottom of a wide trough-like mature-looking valley of moderate depth (perhaps 40 to 50 feet below the general level of the country). Mr. O'Connor tells me it preserves this character for several miles to the northeastward, indeed, to and around its easterly bend. Now this valley, as will presently be shown, is very much older in appearance than any part of the Tracadie below it; and furthermore it was obviously formed by a very much larger stream than that which now occupies it. It must be a fact, therefore, that it does not represent the original head of the Tracadie, but is part of an older northeast-southwest valley. Our best maps (the timber-line plans of the Crown Land Office, followed by the accompanying map), show that this valley lies exactly in line with the present Caraquet valley, and I have no doubt they are parts of the ancient *Caraquetian Valley* described in the preceding note, (No. 93), where also the position of its probable head in Tomogonops-Portage River is discussed.

The great bend of the Tracadie to the eastward I have unfortunately not seen. At the uppermost point I reached in ascending the stream on foot from the South Branch, viz., just east of this bend, the stream is of a meadowy, smoothwater, winding, sand-bottomed type, a character which it holds, as Mr. O'Connor tells me, all the way from the portage road. But the valley here is much narrower, steeper-walled and newer in appearance than is the part above, and also deeper, perhaps 70-80 feet below the general level. Descending, the country becomes somewhat lower, and the river becomes gradually swifter and shoaler, rippling in a clear stream over gravel and small stones, sometimes carving into high banks of glacial drift or of the greatly-jointed soft gray sandstone which constitutes the bed rock of the entire valley of the Tracadie. It continues thus down to the North Branch. This part of the river has more drop than any other part of the main Tracadie, and under present conditions would form difficult canoeing at low water. But the present character of this, as of many other New Brunswick streams, is no index to its original character, Mr. O'Conner has told me from his personal

knowledge of this river, and I have been told by other lumbermen of other New Brunswick streams, that the great quantities of logs now driven at a time down a stream, especially when supplemented by the great rushes of water when the splash, or driving, dams (of which there are several on the Tracadie) are opened, cause an extensive tearing away of the soft banks, making the river-beds much broader and much shoaler than they were originally. This subject should be kept in mind in studying the ancient routes of Indian travel, and will explain why several New Brunswick routes were much used by the Indians where now a canoe could be taken only with very great difficulty, or even not at all.*

The North Branch, so far as I have seen it, some two or three miles up, is also in large part a meadowy, sand-bottomed, smooth-water stream, up which even now in low water a canoe could be worked with little difficulty. The valley, which is some 40 to 50 feet below the general level of the country, though small, is moderately open and mature; and, since it continues exactly the direction of the main Tracadie below it, I have no doubt it is morphologically the head of the Tracadie, while the present main stream, from the mouth of the North Branch northwesterly to the great bend, represents a branch which has worked back across the ancient watershed and captured the head of the Caraquetian Valley.

Below the North Branch the combined streams form a shallow, rippling, cold and clear-water river, winding somewhat in an open and seemingly rather mature valley, washing at times against high glacial banks or low cliffs of sandstone, the jointed pieces of which are washed out to form small angular boulders in the stream. These small sandstone boulders are practically the only ones found throughout the length of the Tracadie, the granite or other crystalline boulders of the rivers of the interior being here quite wanting. Such is the Tracadie down to the South Branch.

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*Possible Indian routes from the Tracadie to Bay Chaleur are discussed in the paper cited in the preceding footnote.

The South Branch I have seen only for a mile or two above its mouth. Mr. O'Connor tells me it rises in three tiny clear lakes, whence it flows eastward with considerable drop, falling at times over rocky ledges or swiftly over stones and gravel, with little stillwater upon it. As far as I have seen it, is a swift shallow stream, in a somewhat narrow valley. Evidently this is a new, if not possibly post-glacial, branch of the Tracadie, draining the eastern slope of the elevated ridge, some 100 to 150 feet above the streams, crossed by the portage road. This ridge, I believe extends southwest to form the watershed between Nepisiguit waters and Tracadie-Tabusintac waters, and northeastward to separate Caraquet from Pokemouche waters, reaching the sea in the elevated land and cliffs at Caraquet. It is in fact the separating ridge between the ancient Caraquetian and Pokemouchian valleys of the primal Northumbrian system (Note 93).

Below the South Branch the river is of course enlarged, and, except for occasional bars, becomes readily canoeable even at low water, despite its shoaling through lumbering. It winds in a somewhat open valley, with a rippling flow and occasional little rapids over gravel, sand, and small stones with occasional glacial or sandstone banks, while gradually pools appear, sand-bottomed and temptingly trout-haunted in the clear white-water depths. The banks, as everywhere above, are densely wooded, and the entire river very attractive. Descending, the stream becomes gradually quieter, sand-bottomed pools are more frequent, smoothwater prevails, the banks are of alder and meadow, the valley opens out more and more, until a mile or more above Meadow Brook the river is winding in a pleasant open intervale basin, which has been partially cleared for camping purposes on the line of the Bathurst-St. Isidore portage road, which crosses here. Descending farther, the river begins to grow swifter again, gradually coming to ripple over a gravelly and stony bed; the valley walls rise rapidly and close in to the river bed, until at Pokemouche Landing, two miles below Meadow Brook, the stream enters a deep gap cut sharply into an elevated plateau, entirely different from anything above.

What now is the origin of the Tracadie down to this point? Since the entire river runs through rocks of uniform hardness (the soft gray Carboniferous sandstones), it is plain that the parts of the river above and below this meadowy basin, being so different in their character, must have had very different origins. Turning now to the maps we notice that the Pokemouche waters here approach very near to the Tracadie, especially at the bend of Tracadie a mile above Meadow Brook; further we note that the Meadow Brook basin lies directly in line with the main valley of the Pokemouche; and further that the Tracadie above the basin is parallel with the northerly branches of the Pokemouche, while (to a slight extent at least) the Tracadie below the basin is parallel with southerly branches of the Pokemouche. All facts taken together seem to make it probable that the Pokemouche formerly flowed across this basin. and the Upper Tracadie was one of its branches, while possibly the Tracadie for a short distance (a mile or two) below the basin was another. This idea falls in perfectly with the theory advanced in the preceding note that the Pokemouche occupies the eastern end of another of the great primitive Northumbrian valleys,—the Pokemouchian Valley, which, extending across this basin, headed in Portage River and the Northwest Miramichi. As to the cause of the turning of the upper Tracadie from the Pokemouche southward into its present course, it is very likely, as will be shown below, that this is in some way a result of the glacial period; and I venture the prediction that the watershed between the Tracadie basin and the Pokemouche waters to the eastward will be found to be formed by a line of glacial drift thrown across the ancient Pokemouchian valley.

Below Meadow Brook, as already noted, the character of the valley changes greatly, the valley walls rising rapidly, until at Pokemouche Landing, two miles below Meadow Brook, the river enters a remarkable gap in a flat plateau. Descending, the valley zigzags abruptly, and its walls rise higher and higher, so steeply withal as to become in places almost of a gorge-like character, with occasional nearly vertical sandstone cliffs. These features become more and more pronounced until, about half way between

Pokemouche Landing and Lord and Foy Brook, the river is running at the bottom of a deep V-shaped valley cut sharply into the surface of a very flat plateau. Nowhere in New Brunswick have I seen a valley so sharply cut into so level a country, features which can be plainly seen since the entire region is burnt to a barren. Below, the country falls off somewhat and the valley opens a little down to Lord and Foy Brook, which, itself in a similar deep valley, enters the main stream in a very pleasant intervale basin. Below this stream the character of the river remains much the same, the plateau becoming slightly lower but the valley remaining narrow down to the Little South Branch, where the entire river swings abruptly to the eastward. Such a character for the valley suggests a rough river bed, which, however does not occur. The flow is somewhat swifter than above, and a few small rocky rapids occur; but for the most part the river runs rippling over gravel or stones, or smoothly through swiftwater pools, a remarkably easy and very charming stream for the canoeman. This part of the river certainly has an attractiveness of its own, especially in the contrast of the pleasing stream and its dense margin of woods with the wildness of the great bare, steep, abruptly-winding rocky valley walls, sharply lined above by their angle with the plateau. But while the valley is narrow, the bed of the river, which is always over drift, never quite fills it, and narrow strips of alluvium occur on one side or the other, with considerable intervale points at the bends.

We consider now the origin of this part of the river. Evidently it has cut directly across a plateau-ridge which is highest half way between Pokemouche Landing and Lord and Foy; and this ridge, I take it, extends southwestward with the sources of the Tabusintac upon its southern slope, and northeastward between the Pokemouche and Little Tracadie, reaching the sea at the upland Green Point, and extending beyond to form the islands of Shippegan and Miscou. It is thus one of the ancient ridges separating the Pokemouchian and the Tracadian Valleys of the original Northumbrian system of rivers (Note 93). But what sent the Tracadie across this ridge? It was, I think, changes

connected with the glacial period. Although the valley is obviously not post-glacial, nevertheless its sharpness of angle and evident newness seems to admit, in view of the softness of its rocks, of no greater age than the glacial epoch. The entire valley has the characters and the appearance of those parts of the Nepisiguit, and of the Northwest Miramichi, which I have described in earlier notes as "inter-glacial,"( or perhaps one should say, "sub-glacial") valleys. I have no doubt these streams are all of the same origin, and all connected with glacial phenomena, and the determination of the exact origin of one will give the explanation of them all. It is very likely that the damming of the old outlet through the Pokemouche, whether this was by glacial ice or solid drift, sent the waters over the lowest point of the plateau to the southward, which point would naturally lie where streams on its northern and southern slopes approached one another at their heads. Thus it is very possible that the comparatively straight reach of the Tracadie below Pokemouche Landing was originally the head of Red Pine Brook, for not only are they in a direct line, but, as Mr. O'Connor tells me, the source of Red Pine Brook is here within a mile of the Pokemouche. On the other hand the part of the Tracadie south of the highest part of the plateau, at least the part for a mile or two above Lord and Foy, was very probably in pre-glacial times simply a branch of the present lower Tracadie below Little South Branch, as was Lord and Foy itself. But more detailed study is needed to determine these interesting details.

The Little South Branch also runs in a narrow valley, cut deeply into the plateau. Its direction continues that of the river below it, of which probably it is the morphological head. Below it the Tracadie valley down to the tide is very much wider than anywhere above, wide enough so that the river winds sinuously back and forth from wall to wall around great intervale points, the windings shown on the map being of this minor character and not major windings of the valley itself. But the valley walls are fairly steep (aside from the places where the stream is obviously cutting into them and forming cliffs), and the plateau

holds its height of from 70 to 80 feet for some distance to the eastward, and then falls off markedly towards the tide-head where it is not over 30 to 40 feet above the water. The bed of the river is yet smoother than above, consisting chiefly of long smooth-water pools and smooth-running reaches over sand and gravel, separated by rippling gravel bars and occasional little rocky rapids. Finally, growing yet smoother and quieter, it merges imperceptibly with the tide, the transition being marked only by stranded and water-logged river drift. Below, along the tideway, the valley preserves in general much the same character, though broadening somewhat, but the walls gradually become higher, the plateau rising again to some 70 or 80 feet above the water. Then it sinks again, until, some three miles above Portage River, it has dropped to 40 feet or less, after which it seems to fall away still more abruptly, to dip rapidly under the waters of the Gulf of St. Lawrence. Through all of its tidal part the river winds considerably, with banks at times of glacial drift, again of sandstone cliffs, but oftenest gently sloping and thus affording sites for the thrifty farms which are extending gradually up the tideway. Often, when the banks are high, it has much of a fiord-character, and everywhere it presents much quiet beauty of scenery. Near the mouth of this easterly part there comes in Portage River, in a ripe-looking tidal valley nearly as large at that of the Big Tracadie. The Tracadie then bends northward through "The Lake" and finds its way to the sea through a complex of lake, cove, point, lagoon, marsh, island and sand beach, all thoroughly characteristic of a sinking coast in a sandy region.

We consider now the origin of this part of the river. It is just possible that it is of the same age and mode of formation as the part above to Meadow Brook; but its much greater size, appearence of greater maturity and marked difference of direction, all indicate that it is considerable older, and I think it is a long pre-glacial, though still comparatively modern river. It cannot however occupy an original valley of the Northumbrian series (Note 93) partly because it is too new in character and partly because its direction is nearly due east instead of north-

east. Furthermore I believe a Northumbrian valley can be traced directly across it, for the Eskedelloc and upper Tabusintac, the depression in the plateau about the head of tide on Tracadie, and the course of the Little Tracadie all lie in a line, and that in the direction proper for the old Northumbrian series (Tracadian Valley of the preceding note). In its easterly, instead of northeasterly direction, it is not unique, since the Pokemouche, to some extent the Little Tracadie, and the Tabusintac, also show this easterly, or even southeasterly, direction for their lower courses, though the Northumbrian valleys can be traced in the northeasterly direction. These easterly courses I presume are connected with the formation of the great trough originating Miramichi Bay, a syncline parallel with Bay Chaleur and Bay of Fundy. It is on the slope of this syncline, I take it, these rivers have been formed, thus acquiring their present directions which represent a compromise, as it were, between the original northeasterly slope of the country and the southeasterly slope of the syncline walls. In pre-glacial times, no doubt, the Tracadie emptied directly eastward just north of Point a Barreau, but since the Glacial Period has emptied through one of the old Northumbrian valleys, a continuation of that of Portage River, the Tabusintian Valley of the Northumbrian system.

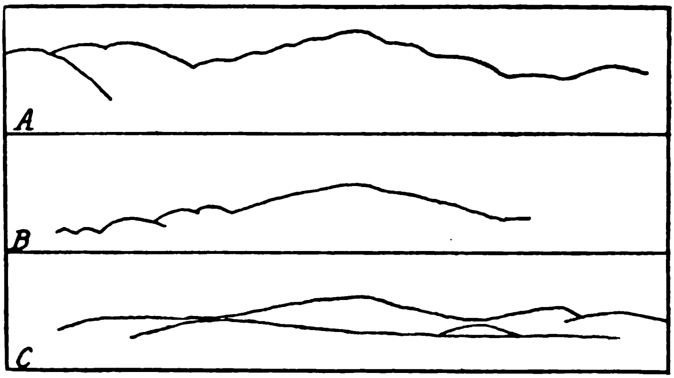
## 95. On the Height and Other Characters of Wilkinson Mountain.

Read December 5, 1905.

Near the source of the Walkemik, or Upper North Branch, of the Little Southwest Miramichi rises Wilkinson Mountain, one of the highest and most important mountains of New Brunswick. In my description of this region in Note No. 87, I gave some account of it, and mapped its approximate position,* but I had not then been on its summit. In July last I was able to ascend it, measure its elevation, and make some other observations which follow.

*As thus mapped it is somewhat too far from Hough Lake; compare the map accompanying Note No. 99 following.

An aneroid measurement made with all the precautions described in earlier notes, and checked for weather from the Fredericton and Chatham stations, made it 2572 and 2524 feet respectively above mean sea level. Its height measured from our camp, the elevation of which was determined by two measurements checked from the two stations, was 2438 and 2424. The mean of these four is 2489 feet. This agrees well with a direct aneroid measurement (910 feet) of its height above Dunn Lake, of which the elevation (1572 feet) was determined last year, and with the fact that it is somewhat higher than the neighboring Thunder Mountain which I made 2468 feet in 1900. My figures are certainly conservative and under rather than over the true amount, so that I have no question this mountain will be found




Sketches of Wilkinson Mountain from a distance. A. From near the southeast angle of Holmes Lake; Thunder Mountain (the double top mountain) is visible on the left. B. From a bare hill above the big bend on the North Pole Branch. C. From Little Nalaisk Mountain on the Serpentine.

to reach fully 2500 feet. Like Carleton and others of our higher mountains, it suffers in apparent height from the fact that it rises from an elevated plateau, itself 2000 feet and more in height. Thus I made the plateau some three miles northwest of it over 2200 feet (Note 98 following). It stands at one end, and Carleton-Sagamook at the other, of the most elevated watershed in New Brunswick, the very roof of the province, that separating the Serpentine from the Nepisiguit and Miramichi waters.

So gradually does the mountain rise above its surroundings that its summit cannot be seen from anywhere in the near vicinity, but its form and relations to neighboring hills can be determined only from a distance, or from its own summit. As to the latter, it affords unfortunately no good view, because it is densely wooded; but from a precarious perch on a tall tree I was able to see that it forms the culmination of a marked ridge much higher than any other land in the vicinity, and of which Thunder Mountain is the southwestern end. As to its appearance from a distance, it is in no respect striking or distinctive, aside from its obvious elevation above all other land in the vicinity. I find happily that I have preserved in my notes sketches of its form as seen from three distant points from which it shows clearly, and these sketches are reproduced in the accompanying cut. The mountain appears to be formed entirely of granite, for all its boulders are of that material, and granite ledges occur upon its flanks, as recorded in Notes 87 and 97.

## 96. Observations upon the Weather of the Central Highlands.

Read December 5, 1905.

During several journeys into the central highlands of the province, I have taken some note of weather conditions, especially as to temperature. In working out the details of various aneroid measurements I have noticed that the temperatures taken with the readings average, as would be expected, markedly lower than those at the central stations at Fredericton and Chatham. I attempted in 1904 to make somewhat exact measurements of minimum night temperatures, but owing partly to a defective instrument and partly to an erroneous method, my somewhat elaborate results proved worthless. But in July, 1905, I attempted to make these measurements with proper methods (hanging the thermometer always over five feet from the ground in an open space), and with a carefully standardized instrument (a Hicks form re-scaled in comparison with a standard thermometer). Unfortunately my trip this time was very short, but the temperatures,

as far as they go, in comparison with those of Fredericton (164 feet above sea level) and Chatham (21 feet) here follow. The localities average about ten miles north of Chatham and eighty miles north of Fredericton.

| Date. | Place. | Elevation | Min. Temp. | Min. Fred. | Min. Chat. |
|---|---|---|---|---|---|
| July 11-12 | 100 feet over Hough Lake........... .. | 1650 | 46 | 52.2 | 54 |
| 12-13 | " " " " " ..... ........ | 1650 | 63 | 61.4 | 50.5 |
| 13-14 | Skunk Lake........ ....... ............. | 1648 | 66 | 66.4 | 64.5 |
| 14-15 | Above Forks, North Pole Branch.. ... | 1200 | 59 | 60.9 | 65.5 |
| 15-16 | Below Forks, North Pole Branch...... | 1175 | 34 | 49.4 | 62. |
| 16-17 | Big Bend, North Pole Branch.......... | 1127 | 39 | 51 9 | 50. |
| 17-18 | Three miles up North Pole Branch.... | 1025 | 57 | 53.2 | 48. |
| 18-19 | Below Forks, Lower North Branch.... | 1070 | 40 | 62.1 | 58 5 |
| 19-20 | Plateau slope near Kagoot Mt......... | 2000 | 53 | 59.9 | 57. |
| 20-21 | Valley between Kagoot and Caribou . | 1700 | 28 | 48.9 | 60 |
| 21-22 | Source South Branch Sevogle..... .. | 1552 | 38 | 50.9 | 50. |
| 22-23 | Forks Clearwater-Sevogle............. | 717 | 38 | 46.0 | 47. |
| | Average | 1376 | 46.7 | 55.2 | 55.5 |

This table shows that while at times the minimum temperature is higher in the Central Highlands than at Fredericton or Chatham, it averages some nine degrees lower, and at times runs very much lower. The most conspicuous case of this is in the temperature 28° on the night of July 20-21. That this is no error of record or instrument is shown by the fact that in the morning we found outside our tent a cake of ice in the bottom of a cup, which was itself frozen to the moss on which it rested. I have noted another striking example of summer frosts in this region. On the sources of the Northwest Miramichi on August 27-28, 28-29, 29-30, 1903, the frosts were so heavy as to whiten all the vegetation around and freeze the water in our pails. Mr. M. I. Furbish has also sent me a note to the effect that once on August 13th at the Waagan water froze in a pail beside his camp to such a thickness that the pail could be lifted by the dipper frozen in it; and it is said there is frost there every month of the year, a

matter of some interest in connection with the agricultural future of that region. Again Mr. Edward Jack records snow on September 30 on the headwaters of the Little Southwest Miramichi (Acadiensis, V. 137).

Another weather phase of some interest, on which, however, I have only impressions and no figures, is the frequency of showers in the Highlands. During several trips I have experienced heavy showers, often to an annoying extent, and they seemed to me much more frequent than I had ever observed elsewhere in the Province. I think it very probable that the Central region is elevated enough to produce rain from clouds which would pass over the lower parts of the Province without precipitation. If this is true, it would not be the forested condition of the country alone which keeps up the summer level of the streams in the Central Highlands, but the larger water-supply as well.

## 97. On the Physical Geography of Miscou.

Read in abstract, Dec. 5, 1905.

The northeasterly part of New Brunswick extends a long angle out into the sea, and, undulating down beneath its surface, ends in a line of peninsulas and islands of which the ultimate is Miscou. An island curiously formed and forever in change, haunt of wild life and center of quiet scenic charm, storied of old, remote from progress, primitive in population, it appeals to our interest in many a different way. But we are concerned now with the method of its origin and the curious facts of its physical geography.

We note first the development of our knowledge of its scientific phenomena, and begin with its geography. Having been the center of a valuable fishery from the earliest advent of Europeans, possessing a very good harbor, and being readily accessible from the sea, it was early mapped by French missionaries and geographers, notably by Denys, 1672, Jumeau, 1685, Franquelin-deMeulles, 1686, an unknown surveyor of 1755, and others, followed more or less accurately by the general maps of

the time. But these maps were merely sketches, often extremely crude, and it was not until the surveys of DesBarres for his famous "Atlantic Neptune" about 1770, that an approximately correct outline appears. The first survey for cadastral purposes was made for the Crown Land Office in 1820 by Deputy Surveyor West, whose large-scale map, corrected and extended by many land-surveys since made, is the basis for all of our present maps, excepting only the Admiralty charts. A new Admiralty survey was made in 1838 on which are based all the modern charts. But no published map down to the present, aside from the very small-scale and generalized surface geology map, and no plan or map in the Crown Land Office, has attempted to show the curious physical features of the island.

Such a map, however, has been made by Dr. J. Orne Green of Boston, who has visited the Island for many years past for sport and health and who has made some study of its geography and natural history. This map, by his kind permission, I have used along with other data,* in compiling the map accompanying this paper.

Of scientific study the island has had very little. Some general references to its characteristics occur in local books, but the

* In compiling the accompanying map, I have used the plans in the Crown Land Office, the Admiralty charts, (especially the large-scale chart showing Miscou Harbor and surroundings), Dr. Green's map, sketches of my own, (notably in the outlines of the upland), and traverse surveys made by myself of the outline of Grande Plaine, and of Lake Chenire and Big Lake. During my three-weeks visit to the Island in August-September, 1905, I was able to examine every part of the shore except the part between Birch Point and the Mal Baie North Gully, and all of the important parts of the interior of the Island except the eastern edge of the principal upland tract—that from Lake Chenire south to Miscou Harbor, which part may be somewhat inaccurate. The geography of the remainder of the island is of course only approximately correct, and owing to the failure of the accessible data to accord with one another. I have had to compromise and "fudge" somewhat. This is notably the case in the vicinity of Cowans Lake and its relations with the Queue of Big Lake. Further I suspect the Crown Land plans I follow for Mal Baie South are in error, and it should be made considerably larger. In order not to interfere with the clearness of the map for physiographic purposes I have omitted most of the names of the less important lakes and other places, as well as all data and names connected with settlement. These are, however, given in full on another map of the same scale accompanying my "Founding of Miscou" mentioned on the next page.

first student to visit it was Moses H. Perley who was there in 1849. He gives some account of its physical characteristics, together with much information about its fisheries and its history, in his well-known Report on the Fisheries of New Brunswick of 1850. Among his other observations he describes the finding of great quantities of walrus bones at Grande Plaine, and this is the original of the frequently (and sometimes incorrectly) quoted accounts of those interesting objects, which are more fully described in a later Note, (No. 98), of this series. No other student visited Miscou until 1886 when Dr. Robert Chalmers, accompanied by Dr. G. U. Hay spent some two weeks upon the island examining its surface geology and botany, with results mentioned in brief in Dr. Chalmers' Report on the Surface Geology of Northeastern New Brunswick of 1888 and shown on his surface geology map accompanying the report. Aside from these I can discover no further mention of the island in all our scientific literature. Dr. J. Orne Green during his many long visits to the island has made observations upon its natural history, especially its bird life, but unfortunately the results have not been published.* Finally, I spent three days on the island in 1904, and three weeks in 1905, making the observations which follow.

Miscou is a famous center for a special kind of sport, the shooting of wildfowl, which resort in immense numbers to its lagoons and lakes; and many sportsmen have visited it for that purpose. But I have not noted any references to it in any of the sporting literature I am acquainted with.

Historically the island is of unusual interest, and much thereon has been published, all of which I have tried to summarize, with the addition of some new material, in an essay on "The Founding of Miscou" to appear with an historical map as part of a Monograph to be published soon in the Transactions of the Royal Society of Canada. The island has a population of some 500 to 600 English and French, mostly following the rich fishery

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*As this paper is in press, I learn that Dr. Green has presented a paper before this Society upon the game birds of Miscou; and doubtless it will appear later in this, or in the next following, Bulletin.

of which the island is a center, and farming a little incidentally. They are a simple, healthy, and hospitable people..

Miscou owes its existence to the fact that this part of New Brunswick consists of a series of ancient, low northeast-southwest ridges and valleys, most elevated to the southwest and dipping under the sea to the northeast. The central one of these elevations (Note 93), probably the crest of an anticline, is the highest, and hence remains longest above the sea-surface, forming the long projection which makes the northeastern angle of the Province. Because of local irregularities this ridge shows as a series of islands just before it vanishes entirely, Miscou being the last of the series. Miscou itself indeed is not a single island but several, joined by bars and bogs. Miscou Harbour, deepening westward, originated no doubt as an ancient valley tributary to one of the great rivers which once flowed along our present Bay Chaleur.

Centering our attention now upon the island itself, we find that it consists essentially of three larger, with several outlying smaller tracts of wooded upland, swelling gently and irregularly above a shallow sea. These upland tracts enclose, roughly, a triangle, and, joined together by festooning bars and beaches which widen in places to plains, they encircle lagoons and lakes with moor and salt marsh. We therefore have to consider, the upland, the beaches and sand plains, the bog-barrens, and the salt marshes.

The outlines, positions, and mutual relations of the tracts of upland are well indicated by the accompanying map, on which their outlines, while mostly merely from sketches, are yet, I believe, approximately correct. The highest points of the respective tracts, which in no case exceed 30 or 35 feet above high-tide level, are approximately indicated on the map. Their surfaces are gently and smoothly undulating, and, except where cut into cliffs by the encroaching sea, dip imperceptibly under water, beach, marsh or barren. They were originally, and are still in part, wooded with a small-sized mixed forest. Doubtless each possesses a core of rock, but I was able to find it in only two places, both on the larger southwestern tract. The most im-

portant of these is the exposure of much jointed and irregularly bedded soft gray sandstones which form the beach and low vertical wave-cut banks at the southwestern angle of the island, the only place on Miscou, according to the residents, where ledge rock shows on the coast. The second place is beside the new highway road a little south of Lake Crenire, where, in a pit dug to obtain material for a new road, the same sandstones appear.* I am told also that ledge rock has been struck in a well near Wilson's Point, and that it occurs on the beach in the harbor. Elsewhere, where the sea is cutting into the upland, as just west of Lac Frye, at Wilsons Point, at Miscou Harbour, at Money Island, south of Eel Brook, along the old bank-line at Grande Plaine, it is working against typical, compact, rather fine-grained glacial drift, which evidently forms much of the surface of the island, affording a soil of fair quality farmed by the residents.

We turn next to the beaches. The shallow sea about the island has, according to the charts and the sailing directions, a bottom sometimes of rock, but usually of sand, while close to the shore it is almost everywhere of sand. Further, excepting for the rocky shores at the southwest part of the island, the stony (small sandstone cobble) reefs off Birch and Wilsons Points, and occasional peat banks at points to be noted below, the beaches between tides are also of sand, gently shelving and compact, affording the finest possible beaches for travel, and, perhaps, for recreation in the future. And in most places the sand is driven by the waves still higher, until, intermingled with driftwood, gravel, cobbles and occasional boulders brought from Gaspe by the ice, it is piled in ridges above high-tide mark. Here the wind drives the drying sand still higher, forming low dunes, up to six or eight feet high, which become sparsely clothed with beach grasses. Such beaches are formed only on flatly shelving shores, never against abrupt upland; hence on irregular shallow coasts

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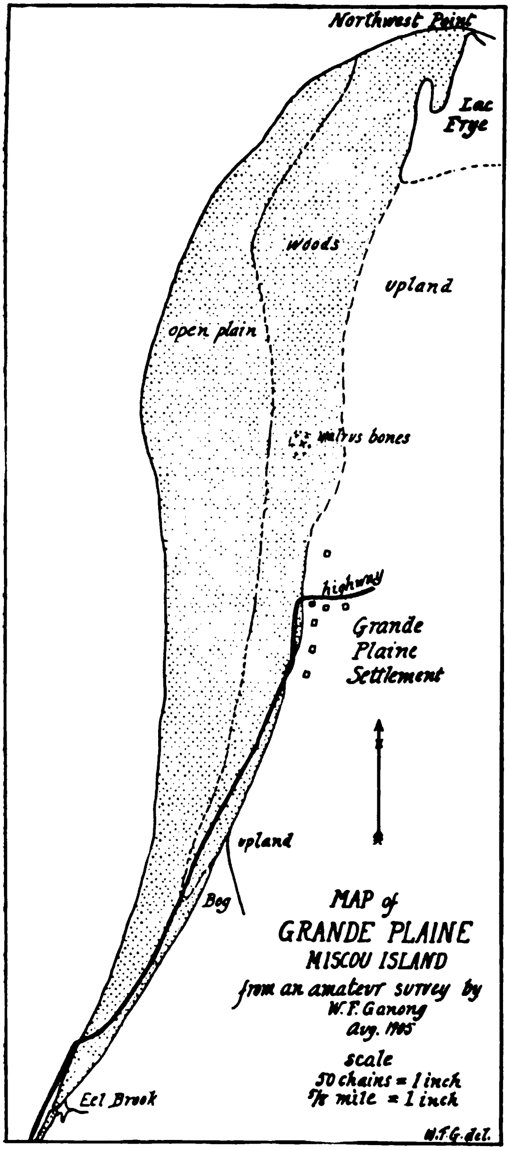
*The "Sailing Directions" speaks of a steep sandstone cliff at Birch Point ten feet in height. Yet as I have myself observed there is no rock visible here upon the shore or elsewhere, and the residents say none is known to them. I think the compact glacial drift forming the bank has been mistaken for a sandstone ledge.

they tend to grow between headlands, which act as anchorages for them, and between which they are beaten in by winds and waves to graceful inbowed curves, often enclosing salt lakes or lagoons. Such a barrier beach, now, however, much modified by changes later to be described, extends from the rocky upland at the southwestern angle of the island northward in a gentle curve to the Goose Lake point, enclosing Herring Creek and Goose Lake. At the Goose Lake point, there is now no upland, but the character of the place, on which stands the Lighthouse, suggests that it possesses a core of upland recently above the sea. From this point another beach runs in a curve to the upland North of Lake Chenire, enclosing between it and the upland a line of low boggy swamps or meadows which were, as recently as 1838, salt ponds or lagoons as shown in the Admiralty charts made in that year. North of Eel Brook, owing to local causes discussed below, the single dune beach gradually broadens into the remarkable great sandy plain called Grande Plaine. From the northern extremity of Grande Plaine the beach extends in a gentle curve to the upland at the eastward, enclosing Lac Frye, while to the southeastward smaller beaches between neighboring tracts of upland enclose two smaller lakes. Then it continues south, with an open gully, to a peaty headland enclosing the salt lagoon, Mal Baie North, and from the peaty headland south to Wilsons Point enclosing, (with a break of the gully), Mal Baie South. A striking fact about the beaches between Birch Point and Wilsons Point, however, is that they have not the usual concave form from headland to headland. The explanation is plain enough. The headland between the two Mal Baies is not of upland but of peat, which is rapidly being eroded away by the sea, and the base of the beach north of it is following it inward, destroying the proper curve. From the upland of Wilsons Point to that near Pigeon Hill, Shippegan, a very typical barrier beach runs in a characteristic great curve, cut by a typical gully, making Miscou Harbor, in its western part at least, practically a lagoon. And beyond Shippegan a very typical series of these great beaches may be traced along the coast, hanging in graceful festoons from headland to headland, all the way to Buctouche.

Thus we see that Miscou Island, while given its general form and size by the remnants of upland not yet sunken beneath the sea, has most of the details of its form, especially its system of graceful inward curves, given it by the barrier beaches festooned from upland to upland.

Such is the present position of the beaches. They are, however, by no means fixed, but among the most highly plastic and unstable of geographical features. Aside from the swinging of their basal ends with the inward moving upland, they show, in Miscou at least, two other marked movements. The first is in the position of those breaches or gullys which, ever tending to be closed by the waves, are ever made anew by the pressure of the accumulated waters inside. The older maps of Miscou all show the gullys of Lac Frye, the two Mal Baies, and Miscou Gully itself, in different positions at different times, and such changes show their traces on the outlines of the beaches themselves. Again, at two points on the shore outside the dune beaches (namely just south of Eel Brook on the west coast, and north of Birch Point on the northeast coast) I found beds of peat, showing that the beaches are moving inward as the island sinks, a point further to be discussed below.

We turn next to that very striking and remarkably interesting modification of the dune beach, the great beach-plain called Grande Plaine. Its general position, form and relations to the neighboring uplands are well shown, in large part from actual survey, on the accompanying map. It is in effect a multiplication of the usually single dune-beach up to some thirty or more parallel beaches, the whole resembling with their crests and hollows a gently-swelling sea suddenly changed to sand. Towards the sea, and for part of its breadth, it is open and treeless, clothed only by the waving beach grass and a few low growths nestling in its shelter; but the other half on the land side bears a low mixed forest, which has obviously advanced on the plain from the neighboring upland. From the mature forest to the open grass of the beach there is a definite step, the transition being marked by very pleasing close-turfed swales with park-like avenues and clumps of scattered trees. This nascent forest proved of such




ecological interest that I made a somewhat careful observational study of it, the results of which, with illustrative photographs, will later be published.* The plain really begins about a quarter of a mile southwest of Eel Brook, where the single dune-beach becomes gradually two by a process seemingly of forking but in reality the result of the gradual addition of an outer newer to an inner older beach. At Eel Brook a third appears and north of that other, all by a similar process of almost imperceptible addition of newer outer beaches, until at the widest part of the plain, there are considerably over thirty of them. The older of all the beaches is of course that which connects the Goose Lake

*Probably in the *Botanical Gazette* for July, 1906, which paper will contain another map of Grande Plaine, in some respects more detailed than that in this paper.

Point, (though it is actually now being washed away at some points south of Eel Brook), with the upland just north of Eel Brook, while the next oldest is that which skirts the edge of the upland, here forming a remarkably regular sea-cut, steep escarpment from one or two up to fifteen feet in height. North of the widest part of the plain, the beaches, hitherto following the curve of the present shore line, swing to the northeast, form the western margin of Lac Frye, and continue straight into the sea, which is cutting directly across their ends. Here the evidence of the sinking of the island is very plain, for not only are the ends of the beaches being cut into those abrupt cliffs characteristic of a sinking shore, but driftwood is actually driven into the hollows between them. Better still is the testimony of the woods, which here continue directly to the margin of the sea which is washing them steadily away, while the peaty woods-carpet is exposed on the beach below high-tide mark.

Such is the general appearance of Grande Plaine. Examining it more narrowly, we find that it is by no means homogeneous throughout its extent. Thus, the dune beaches are by no means of equal breadth, height or distance apart. Because of various irregularities they show, it is by no means easy to measure exactly either their distances apart or their heights. The following figures express approximately the distance in paces from crest to crest of the beaches in a section from the sea to the upland at the widest part of the plain;—24, 17, 18, 17, 44, 26, 25, 12, 25, 32, 42, 96, 45, 20, 47, 68, (edge of woods), 15, 23, 18, 17, 15, 14, 11, 15, 14, 35, 31, and a few others not measured. In general the older inner beaches are both nearer together and more regular in size and height than those farther out. The irregularities in height are marked, some of the crests rising five, or perhaps, six feet above the intervening hollows, others only a foot or two. Furthermore the height-fluctuations are by no means uniformly distributed. Thus two of the beaches, which are also the widest, those marked 44 and 96 above, are markedly higher than others, and these higher ones can be traced for a long distance along the plain. Variations of another kind are shown in the remarkable swales, characterized by peculiarities of vegetation which I shall

discuss in my paper on that subject, and in the low places where standing pools of water occur. Furthermore, the vegetation itself expresses a marked break in the continuity of the plain-building, for there is an abrupt break between the older and larger trees on the inner narrower beaches, and the much younger trees on the swales and outer beaches. All these fluctuations show that the growth of the plain has not proceeded uniformly; and it is probable that a more careful study than I was able to give the subject would throw some light upon variations in the action of geological agencies in recent times.

In viewing the successive beach lines, the question naturally arises as to whether the inner are at a higher or a lower level than the outer. It is impossible without accurate levelling to tell this from a study of the plain at its widest part, but reliable testimony is available elsewhere. Just north of Eel Brook the entire breadth of the plain can be seen at a glance, and there is no question as to the levels; the inner beaches are much lower than the outer, to such an extent that the entire plain has a marked slope inward. Again, at the northern end of the plain, where the sea is cutting it directly across, the height of the outer beaches may be seen to be considerably greater than that of the inner, on which the forest now being washed away by the sea is hardly above the highest tide level. Further, the fact that the inner margin of the plain near the upland is in places little more than an alder swamp, points to the same conclusion. I have no doubt that as a whole the inner beaches average throughout of lesser elevation that the outer, precisely as we would expect on a sinking coast.

We consider now the mode of origin of Grande Plaine, involving the explanation of the anomaly of extensive land-building upon a sinking coast. There can be no question that the growth of this plain, from the very sharply-marked bank-line of the upland out to its present position, has been very recent, and also that it is still in active progress. The residents maintain that the plain has grown from about the margin of the woods to its present margin within the memory of men now living. This must be a great exaggeration, but the occurrence of the walrus bones within the margin of the woods, with their evidence that

these animals were slaughtered by man, (Note 98) presumably upon or near the then beach, shows that there has been this much growth, (a quarter of a mile), within historic times. Several questions are involved in the problem of this growth. First, as to the source of the materials. This is principally sand derived from the rapidly wearing upland of the island and vicinity, supplemented by a great quantity of drift material, wood, eel grass, etc.* All of the residents agree that the cove opposite the plain is a sort of huge eddy in which the drift, worked along the coast by the westerly winds, meets a tidal current sweeping around the north end of the Island from the east and bringing its own contribution; the collective material is there driven by the prevailing westerly winds upon the beach. Certainly immense quantities of driftwood are beached here, enough to supply the residents of Grande Plaine with most of their firewood,and a vast quantity besides. Great masses of eel grass are also brought here after gales, and, becoming buried in sand, help the rapid growth of the shore of the island. Of course, in lesser degree, sand and gravel and other material are worked into this cove in the same manner. Second, we consider the causes which have determined the plain-building in this particular place. The sharpness of the bank-line of the upland, (so obviously an ancient sea-margin that even the residents speak of it as such), shows that comparatively recently the sea beat directly against the upland, and the change to beach-building was very abrupt. Although the plain is evidently rapidly growing about its middle and widest part, it is being washed away at its upper end, so that it is in part material from the upper end of the plain which is forming its middle portion. In fact all the phenomena seems to me to agree in showing that the plain formerly extended, no doubt accompanying a band of

*Although the upland of the island is being everywhere washed away by the sea, in two other places a certain amount of beach building is in progress, namely at Birch and at Wilson's Points. The residents, however, agree that this active beach-building has been in progress only about two years, prior to which both places were rapidly washing away. The building of these places, if not indeed of Grande Plaine itself, must resemble that of the "forelands" of Nantucket, Mass., as recently described by F. P. Gulliver, (Report of the eighth International Geographic Congress, Washington, 1905, page 146).

glacial upland, much farther northward, its position being indicated by the shoals marked on the charts and described in the "Sailing Directions." At that time the eddy would also have been farther north. It was the sinking of the island which permitted the sea to cut off its northern end and roll it, so to speak, with the eddy, down the coast, a process still in progress.* And it will no doubt continue until all of the plain north of the upland, with Lac Frye (once, apparently, a lagoon like Mal Baie and perhaps earlier a fresh-water lake) will have vanished, and a much broader plain will have grown gradually southward, filling the cove north of Eel Brook. Finally we consider the exact details of the mode of building of the successive beach lines, which, clear enough in the cases of the single barrier beaches, is not so obvious where these form a multiple series. In this beach-building, I believe, the presence of the drift wood, eel-grass, etc., plays an important part. All stages of the process may now be seen in operation. The sea at ordinary tides throws the drift wood (largely great trees and cut stumps washed out of rivers by the freshets, with refuse from the mills, etc.) on the beach and the highest tides push it yet higher, until finally some combination of great tide and strong storm pushes it entirely beyond reach of the waves. Then the dried sand, driven landward by the winds, collects among the wood, and gradually buries it in a low dune beach. Meantime the beach grass, succeeding the first beach plants, takes possession and gradually binds the sand so that it no longer moves with the wind. At the same time the beach is growing outward, more drift wood is accumulating, presently a new dune-core is formed, and so on in successive lines. That the drift wood does thus form a core in the beach is shown by the pieces projecting from the various outer beaches, though from the inner this has all vanished by decay. It may be that the

*The abrupt transition between the forested inner beaches and the swales and outer beaches, a transition shown not only by a difference in age of the trees but also by the step from narrow sandy beaches to broad swales, indicates, I believe, an interval between the building of the original Grande Plaine, and the addition of the new beaches from material rolled down the coast. I have, perhaps, made this point clear in my paper (above cited) on the vegetation of Grande Plaine.

need for some combination of great storm and tide to place the core of drift wood above reach, of all ordinary tides explains the fluctuations in the breadth and elevation of the beach lines; the greater may represent the result of some unusual combination of these influences. Further it may be that fluctuations in the supply of the drift wood will explain the variations in the regularity of the beaches. Thus it may be that the lesser size and greater regularity of the inner beaches may be correlated with the fact that they were formed prior to the days of lumbering when the supply of drift materials would be both smaller and more regular than since the settlement of the country. Further, causes of minor irregularities in the outer beaches are found in the operations of the residents nearby whose cattle destroy the beach grass allowing the dunes to blow to pieces, and whose wood-gathering teams cut the beaches in various ways.

So much for an outline of the formation of this interesting place. My study of it was very general, and much remains still to be made out. It will repay a far more detailed study than I was able to give it.

A plain-building on another principle is in progress now south of Goose Light. Formerly this coast was fringed by a single beach inside of which was a line of ponds, surrounded by bog and marsh, including several ponds shown on the Admiralty chart of 1838 but now replaced by bog or marsh. In recent times, as a result, I am told, of the destruction of the beach grass by cattle, this outer beach is being blown by the wind on and across the old marsh and bog, covering it with a sand plain and forming new beach lines against the upland. In this way Herring Creek and Goose Lake have been greatly lessened in size and are now threatened with total extinction. At first I thought that Grande Plaine itself had been formed in this way,—by the advance of the beaches over a flat country carried by the sinking of the land under the sea; but further study has convinced me of the correctness of the explanation above given. Near Herring Creek, both on the north and south of its former outlet, occur the highest and most typical sand dunes I have found in New Brunswick.

They are some 20 or 25 feet high, of pure rolling sand, and are overwhelming the old forests formerly standing there.

We turn now to the consideration of the great moors or bogs, or, as the residents call them, barrens. They cover well-nigh half of the area of the island, filling in the space enclosed by the tracts of upland, and lie to some extent beneath the beaches outside them. They are as typical and finely developed raised bogs or Hochmoore as it would be possible to find, resembling physically and ecologically those I have described from Charlotte County.* Because of their greater extent they show more fully the hochmoor characters than do the Charlotte moors. Every gradation in structure is presented, from the typical flat bog (Flachmoor), heavily wooded and verging to swamp, on the western side of the island (especially in the angles both north and south of Eel Brook), up to the raised, treeless, pond-dotted Hochmoors of the central and eastern parts. Here they form low elevations, rounded hills or ridges with intervening hollows and valleys, the whole simulating curiously, especially when tiny rills or deadwater streams occupy the valleys, the topography of a country of ripe and low relief. At the highest parts the mosses seem dead, but about the ponds they are still in growth. The basis of the moor is of course sundry species of sphagnum, forming typical rounded hummocks and polsters, on which grow the dwarfed Myrica, Ledum, Vaccinium, Rhodora, Kalmia glauca and other heaths with the various associates usual upon New Brunswick raised bogs. Scattered about are the little islands of dwarfed spruce and the many ponds and lakes. These ponds are of all sizes from little pools that one can almost leap across up to the large Lake Chenire and Big Lake, lakes of apparent considerable depth, the latter nearly three miles in circumference. They stand also at all levels, from those near the highest part of the bog, down to Big Lake and Lake Chenire, not much above the level of the sea; and it often happens, as on other moors, that two lakes but a few yards apart differ several feet in level. All these characteristics however are common to all hochmoors and need no special description here. There is however a striking peculiarity of Big

*In Transactions Royal Society Canada. III., 1897.

Lake, true also to a lesser extent of Lake Chenire, namely, its banks are formed of vertical walls of peat, some six to eight or more feet above the water, which are being cut away by the lake itself.* They thus resemble exactly the peat-cliffs bordering the sea to the eastward. Here, at places shown on the map on the two Mal Baies, on Miscou Harbor along Muddy Brook, and on the open sea between the Mal Baies, the moors are being eaten into by the sea, the peat forming vertical cliffs from one or two up to eight feet in height. This is particularly striking on the coast between the Mal Baies, where the sea is rapidly cutting into the low peat cliffs, carving them precisely as it carves a soft-rocked coast. I suppose there is no doubt that the two Mal Baies were recently fresh water lakes like Big Lake, and that the encroaching sea will presently eat its way along Eel Brook and cut into Big Lake converting it into a salt lagoon. The outlet of Big Lake now falls a foot or two over sand and gravel into the salt water.

But how did these moors originate, and what influences have given them their present form? It is, first of all, plain that they were formed when the island was much larger and much higher above the sea than now. Sphagnum moors can only form in fresh water, and they extend much beyond the present limits of the island, since they occur outside the dune beach on the west of the island south of Eel Brook, and again outside the dune-beach north of Birch Point. Further, they must have extended far off to the eastward to permit thick peat beds now to border the sea. Their formation implies the presence of a great shallow impervious basin with a complete rim of upland, a rim now sunk beneath the sea and represented in the extensive shoals on the west side of the island, and by the shoals and reefs off Birch Point and Wilsons Point (described on the Admiralty charts and "Sailing Directions") on the east. Probably the margin of this basin was formed by glacial upland, not by rock, which will explain perfectly its total disappearance. The sinking of the land

*Big Lake shows in one or two places sand beaches against the peat-cliffs. At first sight the peat seems to rest upon them, but examination shows that they rest against vertical walls of peat.

permitted the sea to enter the original basin and then to eat away the bog itself. The ocean has since gradually advanced, cutting away the peat, entering large freshwater lakes and converting them into saltwater lagoons, and throwing barrier beaches across their open sides. This process is still in progress and will no doubt continue until all the moors will be removed and the barrier beaches from east and west will meet in the line of the upland across where now lies Lake Chenire.

Salt marshes occur in the very sheltered places in the angles of the lagoons and along the quiet salt-water streams, as shown on the map. They are of considerable economic importance for their wild hay, but they have had little part in the building of the island. Small areas of freshwater meadow occur in places, as along Eel Brook below Lake Chenire and elsewhere; and there are some areas of true swamps, but these are not of sufficient size or definiteness, and especially are not well enough known to me, for representation upon the map.

Thus we see that physiographically Miscou is one of the most interesting of the parts of New Brunswick. It represents an area of unstable equilibrium, and owes its characters to delicate adjustments of level. Nowhere in the Province are topographical changes in more active progress or their operation so clear.

## 98. On Semi-Fossil Walrus Bones from Miscou and Elsewhere in New Brunswick.

Read December 5. 1905.

The evidence as to the former occurrence of the walrus, or sea-cow (*Trichechus rosmarus*) in New Brunswick is summarized in an earlier note (No. 80)* of this series. Since it was written I have been able to study the principal ancient resort of the walrus at Grande Plaine, Miscou, and to collect there the bones

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*One historical reference to be added to those there given is found in a document of 1756 which states that the Acadian refugees at Miramichi at that time had to live in part upon sea-cow. (Raymond. *History of the Saint John River*, 121).

which have been placed in the Museum of this Society.* The bones occur at the locality marked on the smaller map accompanying the preceding Note (page 456), in which also is discussed the mode of formation of the remarkable beach-plain on which they are found. The place is now over a quarter of a mile from the sea, well within the margin of a sparse spruce wood, and covered by its mossy carpet. At the place of their greatest abundance they are scattered over an area of an acre or so, and are manifest to the eye either through the whiteness of an occasional exposed portion, or else by the mossy hummocks covering the skulls and larger bones. As a rule they are scattered or isolated, though at times small groups are found together in their natural relations, though no skeletons anywhere near complete can now be found. Most of the bones are much decayed, though the skulls and lower jaws, with femurs and a few others, have been fairly preserved through their great hardness. A noticeable fact about most of the skulls is that they show the large bullet holes into the brains by which obviously the animals were killed, while the marks of the axes by which the tusks were hewn out of the skulls are visible upon all of them. These signs confirm the testimony of both history and tradition which state that this was a famous hunting ground for these animals at the first settlement of the country. The bones lie partly imbedded in sand, a very poor material for their preservation, and so far are they decayed that it will be now only a few years before they will all have crumbled away; and then this last visible testimony of the former occurrence here of the walrus will have vanished forever. For some time to come, however, the visitor will be able to make a selection from the piles which I left beside the path, having collected them in the selection of those I brought away for the Society, and it is one of these piles which is shown on the accompanying photograph. Although this is the principal locality at

*These bones include a very large nearly complete skull, another cloven skull, two lower jaws, part of a tusk (found at Goose Lake, Miscou, and given me by the light keeper), two femurs, two vertebræ and a rib. These were selected as the best among a large number dug up and examined.

Grande Plaine, a few occur elsewhere,—on the edge of the woods to the southwest, as I have myself seen, and towards Northwest Point as reported by residents, though I was unable to find the latter locality. I have, however, under the guidance of Mr. Jas. Bruno, keeper of the Goose Light, seen a few walrus bones uncovered by the shifting of the beach south of that light.

So much for the Miscou localities. Although I have made many inquiries I have been able to learn of but a single other place of occurrence of walrus bones in all New Brunswick. The Museum of the Miramichi Natural History Association (see their Procedings, IV., 58) contains a walrus jaw presented by a resident of Burnt Church. I am informed, however, by Dr. Philip Cox that it was found on Portage Island, and also that he had searched there exhaustively for others but without avail. As the walrus no doubt formerly resorted all along this coast, and was probably hunted here as at Miscou, its bones must have formerly occurred here. But they have probably all been washed away by the sea, which is everywhere encroaching rapidly upon this coast. It is only the remarkable and unique conditions which prevail at Grande Plaine, Miscou, (where, owing to local causes, the land is being built out instead of removed), which have preserved the bones in that locality.

So far as I can learn, the bones now in the Society's collection are the only ones from Miscou in any museum. Dr. Chalmers collected a number some years ago for the Geological Survey of Canada, but I am informed they were not preserved and are not now in the Survey Museum. References to the bones at Grande Plaine occur in Perley's *Report on the Sea and River Fisheries of New Brunswick,* 1850, 33, in Ells' *Report on the Geology of Northern New Brunswick,* 1879-80, D, 43, and in Chalmer's *Report on the Surface Geology of Northeastern New Brunswick,* 1888, 27 N. A reference to their expected (but unrealized) occurrence in shell-heaps in the Bay of Fundy is in Boardman's *Naturalist of the Saint Croix,* (Bangor, Me., 1903), page 242.

**Bones of Walrus, Grande Plaine, Miscou, photographed in September, 1904.**

## 99. On the Physiographic Characteristics of the North Pole Branch of the Little Southwest Miramichi River.

Read in abstract January 2. 1906.

The Little Southwest Miramichi, one of the largest, and certainly the most typical, of the wilderness rivers of New Brunswick, is formed by the confluence of five great branches. The two most important of these, the Tuadook and Walkemik Branches, are somewhat fully described and mapped in earlier Notes (Nos. 55, 86, 87), while a third, morphologically the main stream, has been also mapped in part (Note 87).* Last summer I was able to observe the larger part of a fourth of the great branches, the North Pole Branch. on which I wish here to offer some comments, illustrated by the accompanying map.† I also saw something of the fifth branch, the Lower North Branch, but must make another visit to it before attempting any description.‡

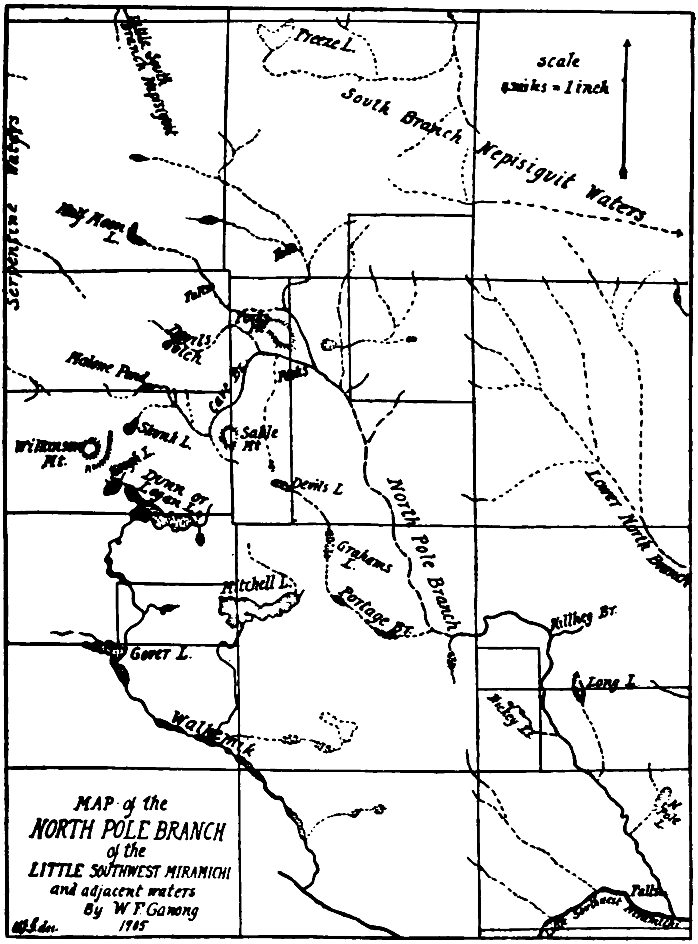
We note first the development of our knowledge of this little-known stream. Because of its remoteness from all settlement, especially at its source, which lies in the very heart of the central watershed in a wilderness still unbroken even by lumbermen and hunters, it has been rarely visited, not at all studied scientifically, and mapped very imperfectly. It makes a first, but naturally crude, appearance in records, however, as early as 1686, on the

*This summer I was able to see also its extreme source, in the two little plateau ponds beside the portage road between Portage and Gover Lakes.

†The map of this branch is compiled from the timber-line surveys in the Crown Land Office, from observations made by us, and from sketches supplied to me by Henry Braithwaite. I hope later to offer the Society a much larger scale and more accurate map of its head waters.

‡I was accompanied by my friend, Professor A. H. Pierce. We were taken by team to Gover Lake via Portage Lake (Tobique) over the portage road. From Gover Lake we went alone on foot, carrying provisions and outfit in packs, and making occasional side-excursions, to Hough Lake and Skunk Lake, Half Moon Lake, Malone Pond, down the outlet of the latter to Cave Brook and the North Pole Branch, down this to near its mouth, across by portage road to the Lower North Branch, up this to the source of the eastern branch, north over the watershed to South Branch Nepisiguit and Kagoot, and down the South Branch Sevogle to Miramichi.

remarkable Franquelin-deMeulles map where it bears the Micmac name of *Kednattequec*.* It makes a second appearance, without




*The North Pole Branch is called by the Micmacs to-day *Kay-dun-at-que-gak*, (meaning unknown), a word which might well be simplified for use to Kednegek (g hard and accent upon the last syllable). The name *North Pole* apparently first appears in documents upon Fish's plan of 1880 and Freeze's plans of 1881, and Mr. Freeze tells me that he found the name in use among lumbermen when he made his survey; and supposed it originated in the old pine-timber days from 1840-1860, when much pine lumbering was done on the river. It was very likely named because of its

name, as a crude sketch upon Baillie's maps of 1832, is shown at its mouth and named the "North Branch" on Berton's Survey map of 1838, and is sketched in its lower courses and wrongly called "Upper North Branch," on Wilkinson's map of 1859, undoubtedly from data supplied by lumbermen. The very first point located by survey upon its course was given by a timber-line survey by Deputy Surveyor Fish, which crossed it west of Long Lake in 1880 (See the accompanying map). The next year Deputy Surveyor Freeze surveyed its lower ten miles, the only part of its course yet surveyed, and in that and the following year ran the several important timber lines which gave us our first knowledge of a large section of this wilderness tract and located several additional points on its course and tributary streams. These were the data which Mr. Loggie had in making his map of 1885, and he was followed closely, though with some slight variations, upon the geological survey map of 1887, which represents the best map yet published of this stream. Since 1881 various additional lines have been run from time to time as the needs of lumbering demanded, giving additional locations for the courses of the various streams; but as no additional surveys whatever of the streams themselves have been made, these are necessarily, both on the Crown Land Office plans and on the accompanying map, simply sketched between the intersections of the timber-lines. On the map I have tried to show the less certain portions by the most broken lines.

So much for cartography, and there is little left to add. Of scientific study there has been none; no geologist has visited the stream, and there is no mention of it in any of the Geological

great extension northward, supplemented perhaps by the coldness of its water. It is commonly shortened in use to "The Pole." Of the other names on the map, *Kill-Heg Brook* was given by Freeze, for a wooden kill-heg or killeck trap found by him there. *Skunk Lake, Half-moon Lake, Devils Lake, Graham Lake, Sable Mountain, Portage Brook, Devils Gulch;* were all given by Henry Braithwaite, presumably descriptive of form or use or other peculiarity. *Malone Pond* was given by us because touched by a timber line run in 1903 by W. Malone. *Cave Brook* was given in 1900 by W. B. Hoyt, descriptively, as he tells me of the physical characters of the stream. *Forks Mountain* is a descriptive name of the lumbermen. *Hickey Lakes* and *Long Lake* are on Fish's plan of 1880 and no doubt are descriptive and for some early lumberman.

Survey Reports or in any other scientific publications. Sportsmen have visited it but little until very recently, and I find but two references in sporting literature. Mr. Frederick Irland was on the North Pole Branch in the spring of 1901, hunting bears with Henry Braithwaite, and he has described his trip in a charmingly-written and beautifully-illustrated article in *Scribner's Magazine* for September, 1901. And there is a reference to Half-Moon Lake, with a crude sketch map showing it for the first time, in Mr. E. Hough's account of his winter trip in 1901 through this region from the Nepisiguit to the Little Southwest Miramichi in *Forest and Stream* for Nov. 1, 1902. Mr. Braithwaite has hunted here for many years and has hunting camps at two of three points, while other guides from the Lower Miramichi are gradually entering the valley and establishing camps. Much lumbering has been done on the stream, especially below the Forks, in connection with which a number of portage roads have been built; but there is still much unlumbered country near its source, between which and the Nepisiguit branches remains the only piece of absolutely virgin wilderness now to be found in New Brunswick.

As the map will show, the North Pole Branch has not a single source, but several, radiating fan-like from a junction south of Forks Mountain. Of these source streams I have seen four, which are as follows. The most northerly is that on which lies Half-Moon Lake, a pretty crescent-shaped little woods lake, 2059 feet above the sea,* surrounded by low plateau hills, showing it to lie in a valley cut a little below the plateau level. The character of the stream above and below it I do not know, except that Mr. Braithwaite tells me it has "granite ledges and falls, 150 feet" upon it as shown on the map. Almost directly south of it on Braithwaite's trail, but separated from it by a mile of two of elevated plateau in a clear-water brook, Devils Gulch, running southeast in a curious little irregular gulch or gorge The rock

*Determined by aneroid checked for weather from Fredericton and Chatham, as were all other elevations given in this paper. Since, however, in all cases I was able to obtain but a single good measurement, and since single measurements are liable to much error, too much confidence cannot be placed in them. The elevation of the plateau south of Half Moon Lake I made over 2,200 feet.

here is granite in great angular blocks piled up like masonry, and the little gorge appears to be not at all of erosion, but of rift, origin. The course of this stream on the map is also from Mr. Braithwaite's sketch. Skunk Lake, 1637 feet above sea level, is a shallow, largely bog-bordered lake lying in a valley formed between Wilkinson Mountain and the Wheeler Mountain mass or plateau east of it, the same in which Hough Lake also lies and which is followed by the trail between the two lakes. It empties northeastward, but I have not seen its outlet. The fourth stream is that near the head of which lies Malone Pond, a most charming and typical little woods lake, whose outlet we followed all the way to Cave Brook and the main North Pole Branch. It leaves Malone Pond as a small stream, soon swinging to the east and the south east, rapidly increasing by the accession of many spring rivulets, and begins at once to develop little gulches or gorges in the granite rocks similar to those already described for Devils Gulch. Continuing southeastward it receives the Skunk Lake branch, and, still rapidly enlarging, developes larger gorges with much fall, separated by quiet alder-bordered sand-bottomed still-waters, often showing, as do the gorges themselves, abundant new beaver works. The stream then swings to the east in the vicinity of a fine great rounded hardwood mountain, Sable Mountain, and then to the northeast, keeping its general character though ever enlarging. The aspect of all the gorges gives the impression not of water-eroded channels so much as rifts in the regularly-jointed and bedded granite. At one place, where Hoyt's timber-line crosses Cave Brook, the stream bed lies in the bottom of a little gorge with vertical granite walls fifteen or twenty feet high. One side of this gorge is angularly concave while the other is an island the angles of which appear to fit into the concave side, showing that here at least the valley is a rift, though the stream has worn also little caves into the joints of the granite thus giving this stream its name. Below, the valley gradually opens somewhat and the gulches become infrequent; the stream is gentler and comes to flow mostly in a winding alder-bordered course through sand-bottomed still-waters. As it swings to the east it receives the shallow clear swift-flowing Devils Gulch

Branch, below which it is a large canoeable smoothwater and stillwater sand-bottomed stream winding amid meadows and alder-intervales down to the Forks (1175 feet above the sea) southeast of Forks Mountain.

The other branch of the North Pole, the larger stream, I have not yet seen above the Forks. The courses of the streams in the map are in part from the timber-line maps and in part supplied by Mr. Braithwaite, who tells me there are granite gorges ledges and falls on the streams shown on the map. I am inclined to think the main stream above Forks Mountain is very sluggish, for a lumberman has told me there is a deadwater or narrow lake, four miles long, on the upper part of this stream.

What now is the origin of these source streams of the North Pole Branch? Turning to the map, three facts are at once apparent. First, to some extent the valleys show evidence of that northwest-southeast parallelism so characteristic of the valleys of this whole central region. Thus there is a line of streams from near Malone Pond southeast along Portage Brook, which, as shown in an earlier note (No 87), probably connected Dunn, or Logan, Lake with the North Pole Branch, while both the Half Moon Lake Branch and the main stream fall in with this direction. I have little doubt that these valley directions are actually relics of the original system. Second, there are at least two valleys, the Hough Lake--Skunk Lake Valley and the Cave Brook valley, having a direction at right angles to the original system. These are very likely homologous with the part of the Tuadook below Crooked Deadwater (Note 86), the origin of which I cannot explain. Third, taken collectively, the source streams now form a fan-radiating system collecting finally into one trunk, draining a great radiating basin or circque, very similar to that of the Walkemik Basin described in an earlier note (No. 87). As in the Walkemik Basin also, the erosion of so many streams appears to have greatly reduced the elevation of the parts of the plateau originally separating them, reducing them for the most part (though with an exception in the case of the great ridge-like Forks Mountain, which must be still of nearly the Plateau height), to low ridges and hills. That such

a basin actually exists north of Forks Mountain, can be seen from Braithwaite's trail north of Skunk Lake, where it skirts the slope of the plateau, and it is implied in a statement made to me by Deputy Surveyor Freeze in speaking of the high range of granite hills crossing the stream at Forks Mountain. Presumably the "Falls" on the map mark the approximate boundary between plateau and basin. The direction of the upper course of this branch would also suggest that there it may originally been emptied into the Lower North Branch, forming the morphological head of that river. But the causes which have thrown these streams thus together, and as well the details of the geography of the basin must await more thorough study than I was able to give it. It seems to me, however, possible that several of the smaller streams may have had their directions determined by the formation of rifts in the granite of the region.

We consider next the valley below the Forks. From above the Forks down to the big bend of the river, it is a smooth-flowing, clear stream of abundant water, winding over gravel and cobbles and with occasional little rapids formed by a few small boulders. All this part forms, in ease of water and charm of scenery, nearly as pleasing a canoe stream as any I know. In but one place did I observe any of the granite gulches so abundant on the upper waters, and that was at the place about east of Devils Lake where the stream, close against the western valley wall, flows through a typical rifted gulch, with low vertical granite walls on each side, but deep and smooth without a fall. The entire valley itself while deeply cut (some 400 feet) into the plateau is mature, wide, drift-bottomed, the river having always a wide stony flat, commonly of the Rhodora-Hypnum-Black Spruce type, on one side or the other. Seemingly the valley was formed by a stream very much larger than that now occupying it, and in any case it has all the characters of an ancient valley and it is no doubt one of the original Northumbrian System (Note 93).

Such is the stream down to the big bend ten miles from its mouth. From an inspection of the course of this curious bend, (1127 feet above sea-level) on the map, on which, since it is within the limits of Freeze's survey of 1881, it is accurately represented,

one would naturally infer that it is post-glacial, the original pre-glacial course cutting across the bend along the courses of the streams and lakes which occur there. And I ventured such a prediction in an earlier note in describing Mitchell Lake and surroundings (Note No. 87). But this supposition is wholly erroneous, for the river preserves its ripe, gentle smooth character all around the bend, and is evidently in an ancient and mature valley. Its abrupt bend to the north is simply a minor winding around drift hills in the wide valley. The origin of the great bend in the valley is of course a question of much interest. Turning to the map we note that it is directly in line with the valley of Portage Brook extending up towards Dunn Lake through the Mitchell Lake Basin (Note 87); furthermore, in continuation of its direction off to the southeastward I saw a marked high gap in the plateau and beyond this gap, in the same direction, there is, as shown on the map, a valley occupied by a brook (Whitney Brook). And I myself noted that where this brook enters the Lower North Branch that valley has a swing in the same direction. I have not traced it farther, but the direction continued eastward would carry it through Guagus to Mullins Stream Lake just below which comes one of those remarkable great bends which characterize all the valleys of this region (Note 93). We may therefore be dealing here with remnants of a very ancient valley parallel with the little Southwest Miramichi and the other rivers south of it, perhaps one of the original Northumbrian system.

But although the course of the river around the big bend is thus very ancient, it nevertheless seems plain that at some time its course was across the bend by way of the Hickey Lakes. Such a valley can be seen from the great burnt hills just above the bend, and seems consistent with the topography of the section as far as known.

Below the bend the character of the river changes for a time; here its course is obstructed with hugh granitic boulders making it very rough. This rapid water extends a short distance but occurs once more a mile or two lower down, where granite ledge rock forms the valley wall. Except for these two places the river seems to retain its gentle attractive character, winding in

great sand-bottomed smoothwaters, often with intervale banks, down as far as we saw it, three miles from its mouth. It is a great surprise to find so smooth a river in so rugged a region, and there is probably nowhere in the interior of New Brunswick so great an extent of good canoeing water, an evidence indeed of the ancient and ripe character of this valley. Just below the big bend, the valley widens into a basin bottomed by an elevated boulder-strewn burnt plain strongly resembling the Graham Plains and probably originating in a similar way. On its western margin runs the North Pole Branch in a deep trench cut into the rough materials of this plain, the boulders of which have here given it its rough bed, while on the eastern margin lies Long Lake, seemingly with a valley extending northward from it. This basin seems to have been a catch basin of the glacial period. Below, the valley narrows somewhat but always is mature and shows a rocky plain elevated well above the river bed. This plain, without doubt a continuation of that above the bend, and similar to those to be described on the Lower North Branch, represents the bed of the glacial rivers which poured their swift waters down these valleys during the melting of the glacial ice. It is into this glacial wider bed the present rivers have cut their narrow and newer channels.

We left this river about three miles from its mouth (finding it there of 1025 feet elevation) and did not see its lower course. But I had previously seen its mouth (Note 54) where it has falls. These are post-glacial, and the original junction with the Little Southwest probably lies a little to the eastward (Note No. 54) in a line with the course of the Little Southwest below it, which is really morphologically a part of the North Pole Branch.

## 100. The Recognition and Utilization of the Plateau Structure of Interior New Brunswick.

Read Jan. 2, 1006.

No doubt most people who know anything of interior and northern New Brunswick think of it as a hilly country only traversable along the valleys. Until recently this was evidently the idea of those whose business it was to lay out portage (lumber-

ing) roads and to explore routes for projected railroads; for all the old portage roads in the interior cling to the valleys as do the earlier routes surveyed for railroads.

In reality, however, all interior and northern New Brunswick is a plateau into which the rivers have deeply cut and it is only hilly where converging streams have carved the plateau to fragments, or where occasional masses of harder rocks have eroded somewhat more slowly than their surroundings.

This plateau structure is in recent years coming to be recognized in practice, for not only do all the newer portage roads in the interior mount from the valleys to the plateau, where they find a drier, more level, straighter and often shorter course from camp to camp, but it is, as I understand it, by the utilization of the plateau, making crossings of the valleys on high bridges in their narrowest parts, that the Grand Trunk Pacific surveyors have been able to locate a practicable, easy-grade route across the province.

# NOTES OF CAMBRIAN FAUNAS.

Continued From Page 406.

curved; the valve also is more ventricose toward the ventral and the posterior sides.

These two fossils are of nearly the same size and a fuller collection of examples might show variations sufficient to unite them under one species.

The Ostracoda referred to at page 454 of the above named article as *Aparchites conchiformis* is identical with *Bradorona* (?) *robusta.*

This species is of larger size than those referred to the genus Indiana, and the valves are more angular in outline, showing a more decided hinge line and a somewhat triangular outline.

**Indiana (?) secunda.** — This species recorded from the upper part of Assise 3 of Band *b* (Protolenus Zone) under the name *Aparchites secunda,* has been found also in the lower part of that assise and in the Cambrian sandstone of Band *b* on Long Island in Kennebecasis Bay. The species approaches a Bradorona in form, but is proportionately longer, and although the outline is too strongly angulated at the end of the cardinal line to be a typical Indiana, we have thought it better to place it here than in Bradorona. It is intermediated in form between *Indiana lippa* and *Bradorna observator,* mut. *ligata.*

## 10. Trilobita.

A further study of material of the Protolenus Zone enables me to add something to what is known of the species of Protolenus.

**Protolenus paradoxoides.** — There are two varieties (perhaps sexual) of this species, the type (described in Trans. Roy. Soc. Can.) with flat narrow cheek, long glabella and narrow interior margin is the narrow form. The sculpture consists of numerous scattered tubercles. The other with tumid fixed cheek and broad interior margin, has a shell densely beset with small tubercles.

This species is distinguished from *P. elegans* by the irregular form and relief of the posterior glabellar furrow and the occipital furrow, such as may be seen in some Olenidæ of the Olenus Zone.

There is a tubercle at the inner end of each posterior glabellar furrow and a corresponding pair at the front edge of the occipital furrow; these paired tubercles sometimes show on three consecutive somites, viz., at the inner ends of the two posterior pairs of glabellar furrows and at the occipital ring. In this view it would appear that *P. bi-tuberculatus* should be regarded as a variety of this species in which the paired tubercles of the posterior somite of the glabellar are unusually prominent.

**Protolenus elegans.** W D.-M — This species is more abundant than *P. paradoxoides* but is of a smaller size. Its surface is minutely tuberculate or granular, or when worn appears punctate. The cheeks are always tumid and the front margin depressed. The occipital furrow is cut straightly and evenly across, and the paired tubercles seen on the posterior somites of the headshield in *P. tuberculatus,* are scarcely ever, and but faintly seen on the heads of this species.

The sculpture is always granular, and the occipital ring directly and smoothly transverse.

Collections made from the Paradoxides lamellatus subzone (C.I. $c^1$.) gives a lower range for some species common in the overlying subzone.

**Paradoxoides Acadicus.** — Two example of this rare species were found in C.I. *c.l.* it is distinguished by the deep, all-across first and second furrows of the glabella.

*Sculpture.*—The inner surface of the glabella is nearly smooth; the outer surface with a strong lens appears minutely granular, but in exact focus the sculpture is resolved into very fine concentric ridges which are crossed by oblique furrows, giving a granular appearance to the surface. The test is thicker than that of *P. Eteminicus* or *P. Micmac.* The sculpture of concentric ridges is faintly discernable on a test whose middle piece is 9 mm. long.

**Paradoxides Regina.** — An example of a broad flat pleura seem to agree best with this large species. It has the

strong traverse anastomosing ridges on the underside that characterize the species.

**Solenopleura Ribbii var.** — A middle-piece of a small Solenopleura occurs. It agrees nearly with *S. Robbii* except that the glabella and cheeks are covered with distantly placed tubercles; there are about twenty on the glabella and half that number on the fixed cheek behind the ocular fillet, and there are a few in front of the fillet.

**Conocoryphe Baileyi.** -- One head of this species. found. The surface is minutely granulate. The common species of Conocoryphe of this horizon is *C. Walcotti.*

### WORM AND GASTEROPOD.

**Orthotheca Micmac** — One example was found with the usual distinct longitudinal striæ.

**Capulus sp.** -- A minnte capuloid shell, smooth, with faint striæ of growth was found—it is on its side and flattened Height 4 mm., width 3 1-2 mm.

## NO. 11—CAMBRIAN FAUNA OF ANSE AU LOUP, LABRADOR.

Some years ago Dr. J. F. Whiteaves sent to the writer a fragment of the fossiliferous limestone of the well-known locality, of Anse au Loup on the Canadian coast of Labrador, where many years ago (1860) Jas. Richardson collected the species of brachiopods, trilobites, tubeworms, etc., which Mr. E. Billings described, and referred to the "Lower Potsdam" horizon.

In these limestones which are 141 feet thick and rest upon sandstones 231 feet thick the following species were found:—

| | |
|---|---|
| Palæophycus incipiens. | Olenellus Thompsoni. |
| Archæoscyathus Atlanticus. | Conocephalites miser. |
| A.—— profundus. | Bathyurus parvulus. |
| Obolus Labradoricus. | B.—— senectus. |
| Obolella chromatica. | Salterella rugosa. |
| O.——? cingulata. | S.—— pulchella. |
| Olenellus Vermontana. | S.—— obtusa. |

Also an Orthis and an Orthisina.

The piece of limestone sent contained abundant remains of the Salterellas with parts of trilobites including those of Olenellus Thompsoni.

The aspect of the surface of layers of this rock is well shown in the wood cut, Fig. 22, page 17, of the first volume of Billing's Palæozoic Fossils representing *Salterella rugosa,* Bill.

Mr. Billings does not mention that these fossils are preserved in phosphate of lime, which however is the case. As a result of the wasting of the limestone from exposure to the weather these fossils stand out prominently from the surface and are readily examined.

On examining these "Salterellas" carefully it was observed that there was no uniformity in the position of the tube within tube that Billings had observed for they were sometimes on one side of the outer tube and sometimes on the other. It is true that in the majority of cases the ensheathed tubes were similar, but in one a young *S. obtusa* was found in one of the rounder tubes referred *S. rugosa,* and one was led to surmise that the supposed sheaths were really independent individuals that had slipped, one within the other and so given rise to the appearance of a tube consisting of sheaths.

A similar condition exists in the tubes of *Hyolithes excellens* Billings found in the upper limestone at Smith Sound, Newfoundland, and of about the same geological age; there this condition of tube within tube is quite common, and the writer has suggested that the younger shell had a habit of taking possession of a dead shell, for the purpose of a firm support on the sea bottom. Whatever the cause, this phenomenon is exaggerated in *"Salterella" rugosa,* which is more frequently ensheathed that *H. excellens* and often shows four tubes, one within the other.

When we come to consider these tubes separately we find that we are dealing with a form which does not differ in any respect from *S. pulchella,* Billings. One should not overlook Mr. Billing's remark (page 18) that this species and *S. rugosa* are not in the same bed, and that the two species are not found together in the same fragments of rock. But while the en-

sheathed tubes do occur quite abundantly on one layer and are not obvious on another closely above or below instances of ensheathing can be found in layers where the single tubes of *S. pulchella* abound.

Mr. Walcott in his studies on the Cambrian Faunas of North America—Bull. 30 U. S. Geological Survey, Plate XIII, fig. 2, shows a good example of this ensheathing of *S. rugosa,* showing apparently no less than ten tubes one with another. This is an unusual number, and can hardly be attributed to accidental conditions; the specimen is from Anse au Loup.

If I am right in my explanation of the cause of the annulations in *S. rugosa*, it will be necessary to retire this name or that of *S. pulchella*. In Billing's publication of the two species *S. rugosa* stands first, but as the name in my view is based on a misapprehension of the characters, and is erroneous in its meaning, it would seem that *pulchella* should be adopted.

But in fact the whole genus *Salterella* of Billings is based on an erroneous view that these shells were species with strong annulations like Serpulites. "*Salterella*" *pulchella* is really a smooth shell, and a strong glass is required to make visible the very fine concentric striæ which encircle the shell.

These regular concentric striæ, the round tube a little flattened on one side and the slightly bell shaped aperture show that in *pulchella* we are dealing with a species of Orthotheca. Numerous examples show that the species was camerated at the proximal end by several diaphragms, convex downward. In no instance have we found an acute point to the shell which is always decollated. If a slender proximal end of rigid substance existed it must have been fragile, and broke away when exposed to abrasion in agitated waters. As Billings remarked, the tube had a slight curve. This was towards the ventral side.

Mr. Walcott has already removed the remaining species of Salterella, *S. obusa,* to the genus Hyolithes. As Salter had already named a *Theca* (=Hyolithes) *obtusa,* Billings name became a synonym. Walcott therefore gave a new name to the species, calling it *Hyolithes Billingsi.* This species, or one closely related is found with the Protolenus Fauna in Southern New Brunswick.

An interesting discovery in this fragment of limestone from Anse au Loup was that of remains of Foraminifera. The porous surface of the shells is not so well seen as in the specimens from the Protolenus Zone in New Brunswick, but the forms are quite similar. *Orbulina* cf.. *universa* is the most common, but other species of Orbulina, of larger size are present. Other species have more than one chamber and so fall into Globigerina, and are similar in form and size to those in New Brunswick; one shows two chambers, arranged like those of *G. turrita*. In a number of the globular forms a depression is found on one side, perhaps marking the orifice of the shell.

The shells of these Foraminifera are in most cases injected with phosphate of lime, which has preserved their form, and by its dark color in contrast to the lighter limestone, causes them to stand out on the surface of the layers like minute black seed.

The shells of the Foraminifera, though generally promiscuously scattered, in some cases seem to be aggregated near the Hyolithoid shells which also are filled with phosphate of lime.

## ARTICLE VI.

# OBSERVATIONS OF WEATHER AND PLANTS, 1905.

BY G. U. HAY.

*April* 1.—A winter of great snowstorms, with very little rain and continued clear frosty weather which lasted up to about March 20. The roads at times were almost impassable, especially in the country near the coast. The branch railway lines in New Brunswick and Nova Scotia were nearly all closed throughout February and the greater part of March, and the trunk lines were kept open with great difficulty and delays to travellers. From the first to the 20th March the weather was clear and cold, thawing in the middle of the day but freezing hard at night. During the last ten days of March the temperature was milder, the heat of the sun causing a rapid disappearance of the not very solid masses of snow, and averting the threatened disaster of a spring flood, which heavy rains would certainly have caused. The average temperature for the month was 29.3° F. A flock of wild geese passed over the city March 26.

### WILD GARDEN, INGLESIDE.

*April* 14.— Alder catkins discharging pollen when slightly shaken. The first fortnight of April has been chilly and damp in contrast with the clear bright days of March. The earth is bare and brown without any trace of green, and snow lingers in the woods and sheltered places. The welcome notes of the early songbirds are heard morning and evening.

*April* 22.—The week has been cold with hard frosts at night, and high winds from south and south-west. Slight snow falls on the 17th and 22nd, but the snow quickly disappeared.

First ploughing on the 27th. North-west winds and sunshine alternating during the last week of April with the ground needing warm rains. Hepatica triloba coming in bloom on the 28th and first mayflowers appearing.

*May* 2.—Hepatica fully in bloom; catkins of the populus tremuloides shedding pollen. Heavy showers, May 1, with cold north-west winds on the day following. First grain sowed.

*May* 6.—Flowers of red maple in full bloom. A few strawberry and white violet blossoms seen. Copious rains on the 6th, and on the 9th. Farmers busy planting on the 7th.

*May* 12.—Frosts on the night of the 8th and again on the 12th when ice one-fourth inch thick was formed, followed by a mixed hail, snow and rain on the 13th.

*May* 14.—Quite cold. A few blue violets in bloom, white violets and strawberry blossoms in abundance; with dandelions, trillium erythrocarpum, caulophyllum, trillium grandiflorum, coming in blossom.

*May* 22.—Wet, cold and backward weather the past week. Trees in leaf: betula papyracea, rowan, acer spicatum. In flower: marsh marigold, sanguinaria canadensis, anemone nemorosa, uvularia sessilifolia, bluets, erythronium americanum, vaccinium canadense, dirca palustris.

*May* 29.—Beautiful weather the past week but the evenings still cool. Amelanchier in full bloom, also trillium erectum, trillium grandiflorum. Upland trees all out in leaf except oak, acacia and great toothed poplar. Prunus Pennsylvanica coming into bloom.

*June* 6.—In bloom: Bog-bean, butter-cup, caraway, also clematis verticillaris, iris versicolor, actea alba. Heavy frost on the night of the 6th, which did much damage on low grounds.

*June* 11.—Three nearly ripe strawberries picked along railway track. The different varieties of pyrus baccata, caragana arborescens (not native) and apple trees in full bloom.

*June* 14—Lilacs coming in bloom. Petals of clematis verticillaris and trillium grandiflorum falling.

*June* 21.—During the past week and nearly all the month up to date the weather has been cold and wet, but grass and foliage have grown abundantly. The weather, June 15 and 16, was very bright and warm, giving promise of summer which was not fulfilled for a week at least. A fire in the grate all day from the 18th to the 21st had to be kept up. Lilacs and honeysuckles in full bloom the past week.

The months of July and August were very pleasant and sunny except at the coast where fogs reigned for many days at a time. September was wet and chilly much of the month, with frosts during the early weeks. Quite a severe frost and keen weather on the 19th, followed by rains. A week later, real autumn days, bright and pleasant, set in and continued during the month of October. Rarely has a finer October been seen in New Brunswick. There was very little rain-fall during the latter part of September or during October and November, and the lakes and streams were correspondingly low.

The first snow fall of any importance was on the 10th of December, which gave good sleighing for a fortnight or more, but there was no severe cold during the month.

## ARTICLE VII.

# WHY IS THE WINTER SO MILD?

By G. F. MATTHEW.

Read February 6th, 1906.

The unusual character of the current winter season has caused a good deal of comment, and certainly there will be few living who can recall such another. Coming after the severe and continuous cold of the previous winter and its accumulated snows, the contrast is very striking. In place of deep snow banks, heavy ice, and the continuous cold of last winter, we have been treated to but one honest snow storm and to repeated periods of mild weather, with some rather heavy rains; so that now the snow has disappeared and the ice on the rivers has become unsafe.

While not professing to be a weather prophet, one might suggest a peculiarity in the weather of the past summer and fall as a probable factor in the present conditions.

It will be within the recollection of some of you that the St. John river during the past season was unusually low—not only for a short time in the later summer as is usually the case, but continuously through the summer and throughout the autumn. We had no autumn rains that were of any weight and consequently there is no "fall freshet." Usually the water in the river at the autumnal period rises sufficiently to cover the lower or marshy part of the intervals, and not infrequently to cover the "high marsh" as well, while occasionally there are autumns in which the "fall freshet" rivals that of the spring.

The level of the water in Kennebeccasis Bay and other expansions of the St. John river is governed not by the rains on the lower affluents of the main stream, but by the rain-fall of the basin of the St. John as a whole.. The level of the water in these lakes at the mouth of the main river affords an excellent gauge of the rain-fall in northern Maine as well as for the principal part of the province of New Brunswick, because it is in such close sympathy with the rain-fall of the upper St. John.

Now all dwellers on the shores of Kennebeccasis Bay will

have noticed how unusually low the water was in that part of the Kennebeccasis river all through the summer, and through the fall as well. Old residents on its shores have told me that they do not recollect having witnessed a similar occurrence of continuous low water in the river. This conditions of things indicated a scarcity of rain throughout northern Maine and New Brunswick during the period in question. But if there was a lack of rain there was more sunshine and in the autumn less evaporation, because the ground was dry. Consequently during the whole period the earth in this region was storing up an unusual amount of heat, to remain there until the winter set in.

During the winter this region has been giving off the latent heat thus stored up, and tempering the winter winds. It is in fact a heat barrier which may be compared to a heating register in front of a window which stops the cold draft from the window. In the same way this warm region arrests the north winds and throws them upward, or modifies their biting severity. More than that, as the extra amount of latent heat here, produces upward currents in the air over this region, there is more than the usual tendency to indrafts from the south, and southerly winds should be more prevalent than under ordinary conditions. Not only so but the west and east winds would be influenced as well.

Many of you are no doubt aware that a "northeaster" is a combination due to an under current from the north and an overhead drift of air from the east, or off the ocean; the former wind dry and cold, the latter laden with moisture; that origin of the northeast rains is not unfrequently well shown by clouds arising in the southeast and rain actually beginning from that quarter, before the "northeaster" sets in.

The point I wish to make in this connection is that the tendency of the air in the super-heated region of Maine and New Brunswick to rise more strongly and more frequently than usual, would tend to convent the northeast winds into east and southeast winds and so bring rain in place of snow. A similar result might be looked for at the opposite point of the compass, for there would be a tendency for south and southwest winds to take the place of southwest and west winds, again bringing warmer air from those directions.

You will no doubt infer that the latent heat stored up in the soil during the summer is gradually dissipated in the winter; the question therefore arises, is the unusual store of last summer now reduced to the normal amount at this season of the year? I think not, for it is well known that the frost this winter has penetrated but a short distance into the ground, and in consequence there is a considerable part of the summer store of heat still remaining. This, as it escapes, will have a tendency to melt the snow from below, and almost imperceptibly reduce its quantity; while the rays of the sun, becoming every day more powerful, will cut away the snow-banks from above, even when snowstorms come, as they no doubt will, to cover the bare earth.

In considering the influence of the unusual amount of latent heat stored up during the past summer in Maine and New Brunswick, in modifying our usual winter conditions, I have made no reference to the last summer's climate beyond these boundaries; that is a lrger question with which I am not prepared to deal, but those who may look farther afield will probably find that the summer changes in the surrounding regions were not dissimilar from those that prevailed in Maine and this province.

To sum up the matter, I may say that the mild winter of this year appears to me to be largely due to the unusually long dry season of the summer and autumn of 1905.

The following notes on mild and cold winter's in this province, are from the pen of Rev. W. O. Raymond, a well known writer on its history.

# OLD-TIME WINTERS IN NEW BRUNSWICK.

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The idea which commonly prevails that our winters are milder than they were in the days of our grandfathers seems to have little foundation. The fact that the present winter has proved an uncommonly mild one is more than offset by the fact that last winter was the most severe of any in the memory of those now living. It is not likely that there has been any material change in the climate of St. John since its discovery by Champlain.

James Simonds, who may be considered as the pioneer of English settlers at St. John, writes of some of the winters of his day. Under date March 6, 1769, he says: "Have had but little snow this winter, but few days that the ground has been covered." Again on Feb. 18, 1771, he writes: "There has not been one day's sledding this winter, and the season is so far advanced there cannot be much more than enough to get the hay from the marsh."

Extracts from the diary of Rev. Frederick Dibblee, the first rector of Woodstock, N. B. also show that mild winters were not uncommon a century ago. On December 25, 1803, he writes: "A fine Christmas, there is not an inch of snow. Ice closed last night." By way of contrast we find that the next winter sleighs had been to Fredericton prior to the 22nd December and found good travelling all the way, which was a thing quite unusual on the upper St. John, the current being in places quite rapid. The winter of 1807 was remarkable for mildness. Mr. Dibblee writes on the 8th. of January: "River open, only five cold days to date, we never had such weather." This was followed a few days later by a snowfall of 18 inches, but on February 19 he writes: "After amazing heavy rains the ice ran today, nothing but a little ice left on the roads and scarce any snow in the woods."

Coming down to more recent times we have evidence of mild winters. A worthy resident of Lower Norton, Kings County, Azor Hoyt, writes in his diary on the 10th February, 1824 "a violent storm, with heavy gale of wind for 36 hours, broke up the river, sweeping away bridges, stacks of hay, timber and fences."

A few days later he writes, under date February 16th: "River opens; carrying off hay from the marsh in my boat." On December 25th, 1829, Mr. Hoyt writes: "A green Christmas, very warm, grass quite green." The ferry at Hampton was in use a good part of the winter. The next winter was even milder. The last of December the river (Kennebeccasis) remained open, with warm weather, and on January 1st, 1831, a warm rain brought the river up over its banks. On March 20 Mr. Hoyt writes. "No frost in the ground, warm all February and March."

The winter of 1839-40 was remarkable for its mildness. About the end of December the Woodstock Times says: "The weather continues highly favorable, and the ground is still bare. The river flows as free as Arno's tide." There was a green Christmas. The winter of 1847-8 was also unusually mild. The St. John river closed about the 20th November, but warm weather and heavy rains caused the ice to run out about the 10th of December. This gave opportunity for Lady Colebrooke to make her famous winter trip from St. John to Fredericton in the Carleton Ferryboat, which bore her name—the "Lady Colebrooke." The boat left St. John on the afternoon of Tuesday, the 14th December, and arrived at Fredericton early the next day. On her return trip she brought a number of students from the university to spend their Christmas vacation, among them Dr. W. P. Dole, who wrote a very interesting account of the trip for the St. John Globe under date 5th February, 1889.

N. B.—As bearing on the question of seasonal changes and the condition of the weather in New Brunswick, attention is directed to the "Notes" of the Director of the St. John Observatory for the past year which will be found at the end of this Bulletin, and also to Dr. G. U. Hay's notes on the Weather and Plants on a previous page.

# APPENDIX.

## SUMMARY OF THE PRESIDENT'S ADDRESS.

A rule of the Society, usually honored by its observance, is that the President shall annually deliver an address. During the term of years in which you have so kindly entrusted me with the position which I occupy I have tried to discharge that duty though quite conscious of the fact that I must fail in the effective presentation of any special subject along the lines of the particular studies of an organization which has in it several eminent students of natural science.

It is recounting an oft-repeated tale to refer to the three summer outings which we had in the year just past. I was not able to get to the first, that on Mr. Banks's domain, at which several of our members came into pleasant contact with nature at least consciously — for the first time — and enjoyed most heartily inspection of some of her treasures; but I was fortunate as regards that at Mr. Hay's summer cabin near our river, and that at the pleasant shack of Messrs. Leavitt and McIntosh in the Nerepis Valley. Those who participated in these delightful outings—not a small number by any means—cannot fail to remember how eagerly they quaffed the wine of delight which nature so generously held out to them as she enticingly urged them to follow her over hills and along pleasant slopes and into charming glens, how readily they looked and listened under sheltering trees as their wise teachers unravelled before their wondering eyes some intricate piece of nature's handiwork and illuminated them with knowledge of the life which seemed no part of their lives, and yet which existed all about them. Those of us who are not in the very centre of this learned society, who can scarcely even be called gleaners in the field of science, and whose best contribution to scientific work is the close attention which we give, the hearty admiration which we bestow upon, the workers who are able to go to the very core of things, who by close study and patient investigation wrest from Mother Earth some of the secrets

which she discloses to her true worshippers, owe much to the gentlemen who plan and who effectively provide such delightful outing days as we had in the year. If there be any pensiveness at all, of which I am doubtful, it can be only in the hearts of those who are not so able as they once were to crawl into dark caves, to jump over running brooks, or to climb the steep hills that are sometimes encountered in the expeditions, which, when one comes up against them suggests a hope that, as in the ballad of the Pied Piper, some mysterious music will open them for us and we shall get to the other side without trouble to ourselves.

In observations which I had the honor to address to the Natural History Society a year ago reference was made among other things to that theory of matter—the monistic theory—which dispenses with the idea of a creative force in, or rather outside of, the material universe, which finds in matter itself and in matter alone all the forces which are sufficient to create worlds, the men and animals which live in them, the trees and plants which cover them, a theory which "has excluded from the story of the earth all questions of miracle, all questions of supernatural agencies in the building of the mountains and the shaping of continents;" which practically teaches that it is an arrange ment or re-arrangement of the atoms of the universe and their relation to each other which makes not alone the material man but also the intelligence which man displays and the intellectual forces which apparently so strikingly differentiate the matter of which he is made up from the matter in the blocks and stones and insenate things which he can use for his own purposes, which things in a general way are supposed to be made for his use.

According to this theory the universe is one great whole and the moral and spiritual life of man is a part of this cosmos; there are not two different separate worlds, the one physical and material, the other moral and immaterial. This may be held to suggest or to suppose a purpose in nature which has not yet been discovered by man, which makes him but a simple element in natural processes, of no special account in the great drama of creation, of no more importance in the general scheme—whatever that scheme may be, if there be a scheme at all—than the

moth whose existence is but that of the summer day; or else it may suggest that there is no purpose whatever in the universe, and that the atoms do nothing but continuously arrange and re-arrange themselves in new forms and shapes and conditions and affinities as do the clouds in the sky. You may recall Shelley's poem in which he describes the cloud, the nursling of the sky, passing through the pores of the ocean and shores, changing but never dying, so that when the pavilion of heaven is bare the atoms of which it is composed come from the caverns of rain, from the earth and water, into which they had receded and build up in the blue dome of air the cloud's own cenotaph, and having done this these atoms in the ever changing state of things as quickly unbuild it again. This might be a poetically descriptive picture of the changing portions of the universe, a presentation in our atmosphere in a short hour of what is done in myriads of years in the creation and dissolution of worlds in the infinity of space. But you may say that this is fanciful rather than exact.

In his address before the British Association at its meeting in South Africa last August, Prof. Darwin, the President, intimated his belief that the stars have a life history, they pass in order from youth to age; the inexorable sweep of time is operative upon them as upon fragile human bodies; like human bodies, although at an indefinitely slower rate, they grow, they attain maturity and decline. But to say this reveals us nothing. "A real beginning of creation evades our keenest scrutiny of material things and their relations," says a writer in a recent issue of the *Monthly Review*. So long as man shall last, says Prof. Darwin, "he will pursue his search into the intricacies of nature and will no doubt discover many wonderful things, which are still hidden. We may indeed be amazed at all that man has found out but the immeasurable magnitude of the undiscovered, will, throughout all time, remain to humble his pride. Our children's children will still be gazing and marvelling at the starry heavens but the riddle will be never read."

At the close of 1905 this is the last word of cosmical science. We know or we think we know that the Pleiades were formerly a nebulous formation in which there were no stars, that they will in the future become a stellar system freed from the frag-

mentary nebulae still attached to them, and we can apply this knowledge to the heavenly system, speculating if we choose upon the fact that the whole universe is subject to the law of evolution, that just as there is a struggle upon our humble earth for the eventual survival of the fittest so there is such a struggle in the world outside and beyond us, and that similarity stands out again in their constructive career, and the process goes on and on, beyond all human conception of time and space.

Interesting as may be the study of methods or theories or suppositions as to the life of the bodies of which we have any knowledge and which make up the universe which we know, this reference to it does not cover any determination on my part to discuss it at any length now. Having stated this I may say that my simple and yet chief desire is to make a few observations along another line. If we refer the origin of all organized matter to a single substance divided into atoms, or into ions much more minute than atoms, and if we accept even in the most modified form the theory that in the protoplasm of this organized matter is the principle of life, that from this substance, out of it, through it, by it, proceeds in some way the simple cell which has developed into man with his high intelligence, marvellous capacity for thought, and filled with hopes of an immortal existence, in what position are we to reject the idea that in everything that grows, in everything which has life, whether vegetable or animal, there is a consciousness of that life; sensations, feelings, and, of course some form of thought. Dr. Hay in an address which he delivered before us on the occasion of one of our summer outings, called attention to the well known capacity of some members of the plant world to seize upon insects for food, and to the sensitiveness of other plants to the touch. In the past summer he interested us particularly in a branch of a tree growing upon his grounds, which showed what might almost be assumed to be an intelligent and an ingenious and surely successful effort on the part of that branch to get out into the sunlight and to secure in a way a very pleasant site for its occupation. In another number of a journal which I have already quoted—the *Monthly Review*—W. T. Clark Nuttall says that it is impossible to refuse to acknowledge plants as sentient beings or deny

that they are capable of experiencing sensations, and that the more we study plants the more impressed we are with the conviction that we have in them a line of development parallel to our own, but one situated in a lower plane, whose scale is pitched in a lower key. I quote a few paragraphs from Mr. Nuttall's attractive article.

"Of late years the student probing deeper and deeper into the mysteries of plant life has been increasingly struck with the analogies that exist between the plant and the animal kingdoms. Over and over again in his researches among plants animal-like characteristics confront him in so persistent and surprising a way that the conviction is forced upon him that, beneath the wide divergences that undoubtedly exist between the two kingdoms, there must be some fundamental term common to both. The living plant and the living animal, remote as they appear to be in their highest developments, must still be bound together by some subtle link. And reflection shows him that that link can be nothing else than the possession of the indefinable quality, life. That which he calls 'life' he realizes must be of the same nature and quality in both kingdoms, and the distinction between them lies, he is beginning to assert, merely in variation as to the quality and intensity of that possession. Indeed it has been suggestively remarked that 'life sleeps in the plant, but wakes and works in the animal.'

"Now when we look down the long vista of the animal world from the highest to the lowest our glance passes from man to apes, past birds and reptiles, fishes and frogs, on by worms and insects and jelly fish, and past the animal communities that we call corals and sponges, until finally we come to the end of the line and find the simplest form of animal life to be merely a mass of living protoplasm enclosed by a more or less definite wall, though still exhibiting certain characteristics of an animal.

"And when we change our point of view to the plant world a similar vista of complex forms successively simplifying meets our eye as we range from chestnut and lily, pines and ferns, to mosses, liverworts fungi, seaweeds and green algae, until at length we come to the simple plants which are also merely a mass of living protoplasm invested with a cell wall, though still en-

dowed with definite plant-like characteristics. Thus then do the vistas of animal and plant life converge towards one another.

"In a problem such as this we can only deduce conclusions by inference and presume similarity in those of our own kind. We can say that others have similar feelings to our own because they act in a similar way to us under similar circumstances—we can never directly test their feelings. And as we work backwards from man there is no single place at which we can stop and say: "there is no sensation here." For wherever there is life there is adjustment to environment—response to external stimuli—and there is no point in the sequence of animal life at which we can assert that the response of any individual is purely that of an automaton.

"And it is this question, the question, 'Are plants sentient?' that plant students are asking more and more closely to-day about the whole plant kingdom in general. For some of the forms of plant-life exhibit so close an analogy to animals in their apparent possession of sensation that, since the sequence of life is unbroken in the organic world, it seems an arbitrary distinction to allow the attribute in one part of the sequence and deny it in another. Some observers, indeed, go even further, and are beginning to wonder whether or not it is not possible that plants may be actually guided by some form of intelligence, an intelligence diffused indeed, and not gathered up into a brain focus, but nevertheless present in some general form. Certain of those who are well-fitted to judge, even make definite affirmations on the point. Thus Professor Shaler, of Harvard University, recently declared that: 'we are in no position to say that intelligence cannot exist among plants, for in fact, all that we can discern supports the view that throughout the organic realm the intelligence that finds its fullest expression in man is everywhere at work.'

"But whether we are justified in presuming intelligence in plants or not, the contention that plants are actually endowed with sensation has been considerably furthered of late by some researches that have been made at Graz by Prof. Haberlandt, a German botanist of some repute. He has been studying the subject specially among the high flowering plants, and as a result

of his investigations he claims to have found definite organs of sense in certain cases. That is to say, he has found and examined a number of plants, as we might examine animals, for organs for the reception of the sensations of touch, and he asserts that he has found complete analogy in many instances between plants and animals in their sensitiveness to contact."

It is not necessary for me to follow Mr. Nuttall in the observation which he makes upon the possession of organs such as that of touch in at least some plants as, for example, the Passion flower, the sensitive plant, the Venus fly trap, in plants which are what we call climbers, whose tendrils are as sensitive at least as the tentacles of the sea-urchin. Tendrils are, he says, like our finger tips, reaching ont into the world to place the individual in its environment. During their time of growth they move in continuous circles round and round seeking with sensitive surface for some support for the plant in its upward climb, and once they come into contact with a solid body the measure of their twining is the measure of their sensitiveness. In addition to this, and the many instances which Mr. Nuttall gives of the sensitiveness of plants, he declares that they are able to transmit a stimulus from one part of their structure to another part. In animals this is, of course, done through the nervous system; the plants have no known nervous system. The idea is now refuted or outgrown that it can be through the cellular system, as each cell is distinct of itself. and his conclusion is that the protoplasm of a plant, continuous through the entire plant, is the medium of transmission, the contents of each cell being connected with those of the adjacent cells by very fine strands which pass through the walls of the cells in every direction. Hence, he says, a plant possesses a complete inner structure of protoplasm hidden within its outer walls, and we have no difficulty in understanding that a stimulus can be carried from one part to another just as nerves carry sensation, for after all what is our nervous system but protoplasm modified in a very special way.

In regard to this, it is well to remember that this view somewhat differs from and disagrees with the recognized theory that there is a central organ—the brain—which diffuses consciousness throughout the system, that in whatever part of the body sensa-

tion—whether by touch or otherwise—is aroused intelligence of it is transmitted to the brain, the central office—which informs the whole body of what it has just received, and thus the entire system is made conscious of the occurrence. Indeed some of the older naturalists made a distinction—which may yet exist—between sensation and consciousness, holding that while man and the higher animals had consciousness the lower animals were cognizant of sensation only. This is easily interpreted into the idea that consciousness is the capacity to express sensation. Certainly so far as an intelligent statement may be made of these things we can easily believe that Dr. Hay's tree in its effort to get into the sunlight, vegetable though it is, shows quite as much intelligent consciousness as is displayed by the clam or the oyster in its environment. Probably a good deal more.

One word more in regard to consciousness only. What is it? Are we fully conscious of all of our own consciousness? Mr. Mallock lately made the observation that "if we call a man's self these faculties and processes which are going on in his own organism, he is as ignorant of the larger part of himself as he is ignorant of what is happening in the moon or the milky way. It is enough, in illustration of this, to mention the case of memory, in which each of us is a crowded register of things which we have never noticed, and of which it betrays its custody under rare conditions only." The common wild rabbit or hare of this country changes its coat in winter, and there are some who believe that it does so in order that by its resemblance to the snow, by its mimicry of nature. it will protect itself from its enemies. Is it conscious of the change, does it put forth a conscious effort to bring this about? Look at that curious insect which is so like the branch of a tree or shrub upon which it feeds, and which we are again told assumes its color and marking so that it may escape its enemies? Is it conscious that it is thus protected? Consider the lilies of the field. Do they, or did they, know that Solomon in all his glory was not arrayed like unto them? But I must end my questionings?

We get back to the fact that as observation is more close and more definite regarding the life upon our planet, to the atoms, the substance, of which the universe is composed, there seems

to be a force, a creative, life-making power in the original elements which is beyond the animal and the vegetable world, which was in the nebulæ and before it, and which is yet in existence; and whatever changes take place by chemical combinations, by differentiation, variation, or whatever word may be chosen to express the idea, or by whatever process these combinations may be brought about, the same principle obtains in all; and it is not difficult to assume that there is an elementary property in the atoms of the universe which gives birth to all the life that the universe contains, built up from the arrangement of these atoms. But this does not explain the whole mystery. The tree grows and so does the man; so does *not* the rock crystal or the diamond, and no one attributes consciousness or sensation to these latter, and yet they are of the elemental substance.

It is well to remember that even in the limited sphere of our own earth the work of creation is not ended, and that apparently there are new creations constantly coming into notice, some of them probably supplementary to, or taking the place of the old. Dr. Matthew easily tells us of transitions of life on this earth in the animal kingdom which have taken millions of years to bring about, and of geologic eras of such duration, one succeeding the other, that no one would attempt to estimate their age. Doubtless we are living in one which some men in the distant future may speculate upon with no consciousness whatever of the thoughts and hopes and fears and reasoning of the men who live today.

In a paper upon orchids which lately appeared in an English magazine, the writer argued that the orchid is a comparatively modern adornment of our earth, and he supported his view with two reasons for holding it, one that the insects—bees and the like—which are necessary to its reproduction—did not come upon the earth until after the carboniferous era; the other that while yellow, white and red colors early developed when the efflorescence of plants began to change from its original green, these colors were well established before blue made its appearance, that the blue orchid is yet rare, because sufficient time has not elapsed for its diffusion or its development.

Assuming then, that new forms of living matter are still

coming on the stage of existence by some process of development or expansion, it is not difficult to speculate upon the possibility, even the probability, of existing forms disappearing as, of course, some forms do disappear through various causes. There are both animal and vegetable growths. once abundant, which exist no longer except as fossils or in some state of preservation in the earth's crust, and there are abundant evidences of the previous existence upon earth of a life of which we cannot now have adequate conception. It is easy to assume that these died out because of changed conditions of temperature or other climatic causes in the regions in which they flourished, through exhaustion of the soil, or in some similar and not unnatural way which no longer fitted them for their environment.

There was a time when the investigations which are carried on by such organizations, as ours, when men who carried them on, were regarded with grave suspicion by those who believed that the knowledge thus acquired might prove dangerous or was useless of itself; and when some discovery was made which conflicted with generally accepted facts, fears were excited in timid minds that the whole fabric of society might be destroyed. That fear may be said to no longer exist generally, even though there be some who yet look with suspicion on the work of the scientific investigator into the doings and the order of nature. These investigations have greatly enlarged the sum of human knowledge and increased the sum of human happiness. Reading lately an essay of Mr. W. Hamilton Mabie, I came across a paragraph in which that writer observes that it is difficult now to realize how completely nature was lost to men during the middle ages, how comparatively untouched human life was by association with the countless aspects of sea and sky. For several centuries the great mass of men and women were so estranged from nature that they forgot their kinship. Of course, in every generation there were men and women to whom the beauty of the world did not appeal in vain, but their perceptions were limited by lack of the larger insight and larger vision. The popular ballads of these days were not lacking in pretty bits of description and sentiment, but nature is subordinate; the sublime background, against which all modern life is set, is invisible Mr. Mabie observes that it is difficult

to imagine a time when men had no eyes for the landscape, and yet, he adds, that is is a notable fact that Petrarch was the first man of his period to show any interest in that great vision which a lofty mountain opens, and which has for the men of today a delight so poignant as to be almost painful. After relating the incident upon which this statement is founded he goes on to remark in a paragraph which we all here will appreciate:

"The redemption of nature from the shadow of sin which, to the mediaeval mind, rested upon and darkened it, has been very slowly accomplished; but the poets, the naturalists, and the scientists have taught us much, and our hearts have taught us more. Nature has become not only an inexhaustible delight, a constant and fascinating friend, but the most vital and intimate of teachers; in fact, it is from the study of nature, in one form or another, that much of the advance in educational efficiency has come; not the improvements in method, but the freshening and deepening of the educational aim and spirit. Nature, through the discoveries of science, has restored balance to the mind, and sanity to the spirit of men by correcting the false perspective of abstract thinking, by flooding the deepest questions with new light, by bringing into activity a set of faculties almost disused, and by adding immeasurably to the resources of the human spirit. In the Middle Ages attention was concentrated upon the soul, and men learned much from the eager and passionate self-questioning; but it was a very inadequate and distorted view of life which they reached, because one of the great sources of revelation was left untouched. In modern times the world of nature has been searched with tireless patience, great truths relating to man's place in the sublime movement of the universe have come to light, and the distorted vision of the inward world has been corrected by the clear vision of the outward world. The study of nature has yielded a new conception of the nature of the divine will expressed through law, of the divine design interpreted by the order and progress of the phenomena of the physical universe, of the marvellous beauty of the divine mind which Tennyson was thinking of when, looking long and steadfastly into the depths of a slow-moving stream, he cried out in awe and wonder, 'What an imagination God has.'"

Men are saner, healthier, wiser, since they began to find God

in nature and to receive the facts of nature as a divine revelation. The soul has looked away from herself and out into the marvellous universe, and learned from a new teacher the wonder, the beauty, and the greatness of her life.

In my address last year I began with a reference to the need which we have for better and more comfortable quarters. This year I close by saying that want still exists, but there is at least a faint glimmer of hope that the difficulties under which we labor will not last forever. Not only do we want more comfortable quarters but we need improved facilities for the illustration of the subjects which are discussed in the lecture room. Those of you who were fortunate enough to hear Mr. Burdett's lecture upn meteors and shooting stars must have been struck by the ingenuity which he displayed in exhibiting his illustrations, but it sharply revealed our poverty. It is worth an effort on our part to overcome these difficulties; for the work of this society is a most useful one—useful in its direct effects and in its influences. In an address which he delivered before the new students of Harvard University in October last President Eliot inquired as o what are the solid and durable satisfactions of life, and after pointing out some of these he emphasized the fact that large mental enjoyments should come to educated people, the great distinction between the privileged class who can look across the ample pages of the Book of Knowledge and the large class who have not that opportunity is, that the former lives mainly by the exercise of the intellectual powers, and gets therefrom a much greater enjoyment out of life. His address was to young men entering upon a college career, but some of his observations are applicable to us all, old and young, men or women. The use of our intellectual power, the steady exercise of our reasoning faculties, the constant acquisition of knowledge will increase our happiness and add to our zest of life, no matter how severe our labor or how many hours we have to give to the procuring of our daily bread. We may not be students of any particular university, but the doors of the great university of nature are never closed; its halls are broad, its lessons fruitful, its studies simple or severe as we make them for ourselves; its diplomas are written upon hearts and minds in indelible ink, the records of success in faithful labor in the earnest search for Truth.

# FORTY-FOURTH ANNUAL REPORT
OF THE
# COUNCIL OF THE NATURAL HISTORY SOCIETY
OF
# NEW BRUNSWICK.

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The Council of the Natural History Society of New Brunswick desire to lay before the members a summary of the work done during the year ending December 31st, 1905.

## MEMBERSHIP.

During the year the membership has been increased by the admission of two ordinary and nineteen associate members, and one corresponding member, making a total of 200.

The following shows the numbers, classes and total enrolled membership:—

| | |
|---|---|
| Honorary, | 4 |
| Life, | 6 |
| Corresponding, | 25 |
| Ordinary, | 55 |
| Associate, | 106 |
| Junior, | 4 |
| Total, | 200 |

## TREASURER'S REPORT.

*Income—*

| | | |
|---|---|---|
| Balance from 1903-4, | $241 93 | |
| Interest on Investments, | 85 52 | |
| Bulletins Sold, | 50 | |
| Mounting Paper Sold, | 25 | |
| Government Grant, | 200 00 | |
| Membership Fees, | 202 00 | |
| Rebate on Ins. Prem., | 1 14 | |
| Collected on Field-day—Oliver's Cave, | 3 50 | |
| | | $734 84 |

| | | |
|---|---|---|
| *Carried forward,* | | $734 84 |
| ***Expenditure—*** | | |
| Maintenance of Museum, | $138 30 | |
| Library Books and Binding, | 13 16 | |
| Printing and distributing Bulletin XXIII, | 160 00 | |
| Sundries, | 170 44 | |
| | | $481 90 |
| Balance Bank of N. B., | | $252 94 |

The above balance of $252.94 includes $33.00 held in trust for the Ladies' Association, and $40.00 for Botanical work as set forth in the 1903 report.

The Society holds mortgage of $1,500.co on Hazelhurst property.

The Society holds mortgage of $900.00 on Cheyne property.

The Society holds special deposit in the Bank of Nova Scotia $100.00. The Society holds special deposit in the Bank of Montreal Building Fund $12.56.

The collections are insured for $3,500.00.

Respectfully submitted,

A. Gordon Leavitt,

*Treasurer.*

January 16, 1906.

## Lectures.

Ten regular meetings, including the annual and one special meeting, were held during the year.

The following are the dates of the meeting and the titles of the papers read:

January 3.—(a) Birds that Hunt and are Hunted, by Mr. A. Gordon Leavitt.

(b) Additions to the list of New Brunswick Plants, by G. U. Hay, D. Sc.

(c) The Curious Phenomenon of a Forest Fire near Neguac, Northumberland Co., by W. F. Ganong, Ph. D.

January 17.—Annual Meeting. Election of Officers.

February 7.—(a) The Magdalen Islands: Their People and History, by Mr. W. F. Hatheway.

(b) Physiography of Grand Lake and its Affluents, by Mr. W. S. Butler.

(c) On the Limits of the Great Miramichi Fire in 1825, by W. F. Ganong, Ph. D.

March 7.—(a) Pain, by G. G. Melvin, M. D.
(b) Archaeological Notes, by Mr. S. W. Kain.
(c) On the Contour Map of New Brunswick, by W. F. Ganong, Ph. D.

April 4.—(a) Notes on Our Insect Collection, by Mr. William McIntosh.
(b) Notes on a Grindstone Quarry at Stonehaven, Gloucester Co., by Geoffrey Stead, C. E.
(c) On the fact basis of the Fire or Phantom Ship of Bay Chaleur, by W. F. Ganong, Ph. D.
(d) Notes on Our Fishes, by Mr. C. F. B. Rowe.

May 2.—(a) The Natural History and Physiography of New Brunswick, by W. F. Ganong, Ph. D.
(b) Bird Notes, by Mr. J. W. Banks.

June 6.—(a) The Hydrography of New Brunswick, by Mr. J. W. Bailey.
(b) Geology of Rockwood Park, by G. F. Matthew, D. Sc.
(c) Report from the Royal Society of Canada, by G. U. Hay, D. Sc.

October 3.—Vegetation of the Earth in remote times and its Relation to Climate, by G. F. Matthew, D. Sc.

November 7.—Gypsum Deposits of Albert Co., by L. W. Bailey, Ph. D.

December 7.—The Physiographic Characteristics of the Tracadie River; On the Height and other Characteristics of Wilkinson Mountain; On Walrus Bones from Miscou Island, by W. F. Ganong, Ph. D.

## Elementary Lectures.

A series of Elementary Lectures or Talks was given in the rooms on Tuesday evenings, not occupied by the regular meetings of the Society, during the months of January, February and March, for the benefit of the Ordinary and Associate members, and for pupils of the public schools. These lectures proved very interesting and were fairly well attended.

The following were the dates and the titles of the papers read:—

Dr. G. F. Matthew gave two lectures on the Elements of New Brunswick Geology, January 10 and 24.

January 31.—A Preliminary Talk on Plant Life, by Mr. Thomas Stothart.

February 14 and 21.—The Trees of New Brunswick, by Dr. G. U. Hay.

February 28.—On Bird Classification, by Mr. A. Gordon Leavitt.
March 14.—On Types of Insects, by Wm. McIntosh.
March 21 and 28.—On Fishes, Reptiles and Frogs, by Mr. Chas. F. B. Rowe.

## PUBLICATIONS.

The twenty-third Bulletin of our Society has been issued and copies sent to the members of the local legislature of New Brunswick and to other Societies. It contains many articles of interest on the natural history of this Province. Dr. W. F. Ganong continues in this issue his notes on the Natural History and Physiography of New Brunswick in addition to papers by other members.

## ORNITHOLOGY.

The numbers refer to the list of birds printed in Bulletin No. 1, 1883.

Species which occur in St. John and Kings counties:

115.—White Gyrfalcon (Hierfalco gyrfalco candicans) now Falco islandus).

The only evidence of the occurrence of this bird in this vicinity given consists of reports from persons who were certain they had seen it, but it now affords me much pleasure to record the taking of a beautiful female, on January 13th in the vicinity of the "one mile house," St. John County, by A. L. McIntosh.

This specimen is extremely dark and would, no doubt, answer the descriptions given of (Falco rusticolus obsoletus) by Cowes, Ridgway and others, but, at present, I prefer to follow McIlwraith who claimed that there was but one species, and not two and also two sub-species.

197.—Ruddy Duck (Erismatura rubida) Ordinarily considered a rare bird.

I reported a male and female in Bulletin XVI. (Page 74), a female in Bulletin XVII (Page 170).

*Note*—During October 1905 I saw in the country-market eighteen specimens of this bird, most of which came from French Lake, Sheffield.

179.—Pintail (Dafila acuta).

The list says: "This species was not uncommon here some eight or ten years ago, but the only known recent instance of its occurrence anywhere in the Province is of a female and young brood seen on the Tobique River in September, 1879, by Mr. Carnell.

*Note*—A male and female seen at O'Neill Bros. stall in the City Market, September 26, 1905, a female at Dickson's stall on October 10, 1905, all came from points on the St. John River, but I could not learn the exact locality.

During the last few years quite a number of specimens have been observed in the market and city stores and it seems in order to now consider this bird as quite common.

A. GORDON LEAVITT.

## LIBRARY.

The work of cataloguing the library has progressed favorably during the year. The books have all been re-arranged and many of the publications in pamphlet form placed in suitable cases. Up to the present time about half of the books in the library have been numbered and recorded on the list but much remains yet to be done. I had hoped to present at the meeting a complete catalogue of our library but other interests have made it impossible for me to devote much of my time to the library of late, and the work is still incomplete. Many valuable books including the transactions of the important scientific societies in America and abroad, as well as the various government reports, have been added to the library during the year and our shelves are now so overcrowded that further accommodation becomes a matter for the Society's consideration.

I would draw your attention to the fact that some of our books have been in the hands of members for many months and although a general appeal at our Society meetings and also through the daily press have been made, they have not been returned. A more thorough system in regard to the distribution of our own Society's bulletin is urgently needed, as many of our valuable exchanges were overlooked during the past year, and

many copies of the bulletin are distributed and this Society has no record of where they go. I wish to express my appreciation of the valuable assistance rendered by the Assistant Librarian, Miss Hoyt, in the work of the library during the past year.

W. LEONARD ELLIS, *Librarian.*

## FIELD MEETINGS.

Three very pleasant Field Meetings were held during the past season, one at the Summer Camp of Mr. J. W. Banks, near the shore of Dark Lake, whence a visit was paid to Oliver's Cave in the vicinity; a second to Ingleside on the 5th of August; and a third to the summer camp of Messrs. A. G. Leavitt and Wm. McIntosh—Camp Nature,—above Nerepis Station on the 26th of August.

These meetings gave the large number of members who attended them a very pleasant outing and opportunities for social intercourse and visiting and gaining information about the interesting localities visited. Talks on the natural history features of each neighborhood—geology, botany, birds, and insects,—were given by the various leaders of the sections, and all the members felt that the time was well spent and voted the Field Meetings a great success.

G. U. HAY, *Chairman.*

## ENTOMOLOGY.

Your committee begs to report that Messrs. McIntosh and Leavitt have devoted nearly all their spare time to collecting during the past year.

Insect collecting has been carried on unremittingly during the past seven years, resulting in the accumulation of a very large number of specimens and a vast amount of valuable data, with the result that henceforth we will be able to speak with some degree of certainty regarding the insect life of this section.

A number of species new to science have been discovered. A list of these will be published at an early data. A number of wall-cases have been prepared; in these are shown all the more common insects of St. John and Kings Counties, and the common

names are given where such exist. This collection will be enlarged during the coming year.

WM. MCINTOSH, *Chairman.*

## BOTANY.

The Botanical Committee reports the discovery of a number of plants new to the province, some of which are from Miscou Island, reported by Dr. W. F. Ganong. These are held over for next year's report.

G. U. HAY, *Chairman.*

## GEOLOGY.

Members of our Society have been engaged in active field-work during the summer, and have been in various parts of the province. Messrs. Leavitt and McIntosh have been studying and collecting in the Nerepis Hills, where the late destructive forest fires have laid bare large areas of granitic and other rocks. They have also been collecting fossils from the well known Devonian plant ledges in Lancaster, and have found some fossils of much interest to the geologist.

Professor Ganong has pursued his studies on the geology and physiography of Gloucester county, tracing the pre-glacial river valleys of the southeastern part of the county, and studying the recent geology of Miscou Island.

Dr. L. W. Bailey has been engaged in the search for fossils in the pre-Carboniferous rocks of York and Carleton Counties, and in obtaining information relative to the economic minerals of New Brunswick. Fossils collected by him were studied by Dr. H. M. Ami and were mostly of the marine animals called "graptolites."

Members of the staff of the Geological Survey have also been working in Charlotte county on the metamorphic slates of that portion of the province. These were Dr. R. W. Ells and Mr. Hugh Fletcher. The geology of this region is very complicated and difficult.

Dr. G. F. Matthew has been busy arranging and labelling the type collection of Devonian fossil plants, collected by the late

Prof. C. F. Hartt and described by the late Sir. Wm. Dawson. No other flora of such richness and of so great antiquity has since been found, so that the value of these types has been enhanced rather than impaired.

G. F. MATTHEW, *Chairman.*

## GENERAL.

The rooms were open as usual to visitors on Tuesday, Thursday and Saturday afternoons of each week. Upwards of three hundred persons availed themselves of the opportunity of inspecting the various rooms. During the year the librarian, W. L. Ellis, M. D., devoted a great deal of his time to the re-cataloguing and re-arranging the books. All paper-covered works have been arranged according to the subjects treated of and placed in receivers; this with a handy reference makes them easily available. Dr. Ellis deserves the hearty thanks of every member for the excellent manner in which the work has been done. It is to be regretted that owing to the lack of space many valuable works have not yet been arranged to the best advantage.

Throughout the year the Ladies' Association heartily cooperated in all the work of the Society, giving their assistance on all occasions.

The attendance at the various lectures was most gratifying and the interest manifested gives good encouragement for the future. On several Saturday afternoons in the lecture room some of the teachers of the public schools gave talks to their pupils on Bird and Plant Life.

The curator, Miss Hoyt, has been untiring in her efforts to promote the interests of the Society. The Council wish to express their thanks to those gentlemen who have prepared and delivered addresses before the Society; to the donors to the museum and library; to the daily press for inserting the preliminary notices of meetings.

# REPORT OF THE LADIES ASSOCIATION OF THE NATURAL HISTORY SOCIETY.

The Ladies' Association submit the following report for the past year:

At the annual meeting held in November, the following officers were re-elected unanimously: President, Mrs. G. F. Matthew; Vice-Presidents, Mrs. G. U. Hay and Miss A. D. Jack; Secretary, Miss E. McBeath.

The membership is still increasing and there are now over one hundred names on the list.

The subject of holding a Fair illustrating the History of Nations was discussed and approved by the members, the proceeds of which shall go towards a fund for a building that shall properly accommodate the Museum and Library and contain a suitable lecture hall.

It is hoped that the work will not be confined to the members only, but will become a matter of civic interest, and that our proposed new building may contain rooms suitable for the Historical Society and the Woman's Art Association.

The following course of lectures opened with a re-union on Thursday, January 5th. There was a large attendance of members.

January 12.—Emerson and Nature, by Mrs. Emma S. Fiske.
19.—Scenes in Rome and Naples, by Mrs. George Murray.
26.—Glimpses of a Quaint Old German Town, by Miss Homer.

February 2.—Children's Day—Nuts, by Miss Ethel Jarvis.
9.—Notes on China, by Mrs. James R. Warner and Miss Purves.
16.—Scenes from the Life of Huxley, by Mrs George F. Matthew.
23.—Some Relics of the French Occupation of Acadia, by Miss Alice D. Jack.

March 2.—Children's Day—Our Feathered Friends, by A. Gordon Leavitt.
9.—The Land of "Kai-ora," by Miss Olive.
16.—Voices from the Meadow, by Mrs. George U. Hay.
23.—Reunion of Members.

EDITH McBEATH, *Secretary.*

K. M. MATTHEW. *President.*

# FREDERICTON NATURAL HISTORY SOCIETY.

The Fredericton Natural History Society is now entering upon the twelfth year of its history. Its meetings are held in the High School building, in the evening of the second Monday in each month, except in the vacation season. During the past year the programme for the monthly meetings was as follows:

1905.

Jan. 9. The Weapons of Birds, by Mr, Wm. Moore.
Feb. 13. The Annual Meeting. The Origin, Growth and Purposes of the Society, by the President.
Mar. 13. Vegetable Ferments, by Dr. John Brittain.
April 10. Some Queer Fishes, by Dr. L. W. Bailey.
May 8. The Hydrography of New Brunswick, by Mr. Joseph Bailey.
Oct. 9. The Gypsum Deposits of New Brunswick, by Dr. L. W. Bailey.
Nov. 14. Photography, by Mr. L. B Kidner.
Dec. 12. Lantern Views on Geology and Astronomy, by Dr. Bailey and Mr. G N. Babbitt.

1906.

Jan, 8. The Wild Animals of New Brunswick, by Mr. Wm. Moore.

To stimulate the younger members of the community to study natural history, the Society has offered prizes for each of the years 1904 and 1905. The 1904 prizes were awarded as follows:

Collection of, and Notes on Weeds; 1st prize, Miss Queenie Harrison, of Nashwaaksis; 2nd prize, Miss Mattie Moore, of Scotch Lake.
Collection of Insects; 1st prize, Master Kenneth Campbell, of Kingslcear.

In the early part of 1905 the Society purchased a reflectoscope at a cost of $150. It has since been used to great advantage in throwing upon a screen representations of the pictures of natnral objeets, or views of the natural objects themselves.

The list of officers of the Fredericton Natural History Society is as follows:

L. W. BAILEY, Ph.D., LL.D., President.
MR. G. N. BABBITT, } Vice-Presidents.
MR. G. A. GOOD, }
B. C. FOSTER, M.A., Treasuree.
G. A. INCH, B.Sc., B.A., Secretary.
MISS ELLA THORNE, } Additional Members of the Council.
MRS. B. C. FOSTER, }
MRS. G. A. INCH, }
MR. WM. MOORE. }

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# DONATIONS TO THE MUSEUM, 1905.

| DATE. | DONOR'S NAME AND DESCRIPTION OF GIFTS. |
|---|---|
| January... | Mr. James Manchester, Pres. of Bank of New Brunswick, Part of Bishop's Memorial Tablet recovered from the ruins of the Cathedral at St. Pierre Martineque. |
| February.. | Miss Alice Rising, A case of Chinese Insects. |
| March..... | Dr. William Matthew, Collection of Minerals |
| | Mr. Duncan London, Several relics of the stone age. also Iron lance of the French period. |
| April...... | A G. Leavitt, Fossil shells snd Minerals found at Nerepis. |
| June ..... | Mrs. Charles Lowe, Specimen of young alligator. |
| October ... | Master Armstrong, Birds nest, |
| | Duncan London, Fragments of earthen pots and stone implements. |
| November | A Friend, Book of pressed seaweeds. |
| | A. G. Leavitt, Specimes of Rocks. |
| | Rev. C. J. Berrie, A plant that had grown and choked a water pipe. |
| December | Prof. W. F. Ganong, Bones of a Walrus. |
| | Prof. W. L. Bailey, Specimens of Gypsum. |
| | Mrs. Gilbert Murdoch. Nest of Trap Door Spider. |
| | Mrs. S. L. Gorbell. Specimen of Gulf weed. |

# DONATIONS TO THE LIBRARY, 1905.

| DONOR'S NAME | RESIDENCE | WORKS. |
|---|---|---|
| Academy of Natural Science | Philadelphia | Procee |
| Academic Imperiale des Sciences | St. Petersburg | Bulletins |
| American Entomological Society | Philadelphia | Circulars |
| American Museum of Natural History | New York | Bulletins |
| Australian Museum | Sydney, N. S.W. | Reports |
| Amherst College | Amherst, Mass | Reports |
| Archaeological Society | Ontario | Reports |
| Boston Society of Natural History | Boston | Bulletins |
| Boston Free Public Library | Boston | Reports |
| Buffalo Society of Natural Science | Buffalo | Bulletins |
| Bureau of Ethnology | Washington | Transacti |
| California Academy of Science | San Francisco | Proceedings |
| Cincinnati Society of Natural History | Cincinnati | Bulletins |
| Colorado Scientific Society | Denver | Transactions |
| Connecticut Academy of Science and Art | New Haven | Bulletins |
| Cornell University Library | Ithaca, N. Y. | Report |
| Comite Geologique | St. Petersburg | Report |
| Canadian Institute | Toronto | Transactions |
| Carnagie Institute | Washington | Report |
| Davenport Academy of Natural Science | Davenport | Proceedings |
| Director Royal Gardens | Kew, G. B. | Bulletins |
| Department of Inland Revenue | Ottawa | Report |
| Entomological Society | London, Ontario | Journal |
| Ethnological Survey | Manila | Report |
| Feuille des Junes Naturalistes | Paris | Journal |
| Field Naturalist Club | Ottawa | Transactions |
| Gray Herbarium | Cambridge, Mass. | Bulletins |
| Geological Survey | Perth, W. A | Report |
| Geological Survey | London G. B. | Report |
| Geological Survey | Ottawa | Report |
| Historical and Scientific Society of Manitoba | Winnipeg | Bulletin |
| Indiana Geological Survey | Indianapolis | Report |
| Iowa Geological Survey | Des Moins | Report |
| John Hopkins University | Baltimore | Circular |
| Linnæan Society | New South Wales | Report |
| Literary and Historical Society | Quebec | Report |
| Liverpool Biological Society | Liverpool | Proceedings |
| Loyd's Museum | Cincinnati | Report |
| Manchester Geological Survey | Manchester | Proceedings |
| Minnesota Academy of Natural Science | Minneapolis | Bulletin |
| Minister of Mines | Sydney, N. S. W. | Report |
| Missouri Botanical Gardens | St. Louis | Proceedings |
| Maryland Geological Survey | Baltimore | Report |
| National Museum Library | Washington | Proceedings |
| New York State Museum | New York | Report |
| Natural Science Association | New Brighton | Bulletin |
| New York Academy of Science | New York | Journal |
| New York Public Library | New York | Bulletin |
| Ottawa Literary and Scientific Society | Ottawa | Bulletin |
| Philadelphia Museum | Philadelphia | Report |
| Public Museum | Milwaukee | Report |
| Queens Quarterly | Kingston | View |
| Rochester Academy of Science | Rochester | Proceedings |
| Royal Academy of Science | Stockholm | Proceedings |
| Royal Colonial Institute | London | Journal |
| Royal Geographical Society | London | Proceedings |
| Royal Society of Canada | Ottawa | Proceedings |
| Smithsonian Institution | Washington | Proceedings |
| South Dekota School of Mines | Rapid City | Report |
| Texas Academy of Science | Austin | Report |
| Tuft's Collage | Mass. | Studies |
| University of Toronto | Toronto | " |
| University of California | California | Report |
| U. S. Coast and Geodetic Survey | Washington | Bulletin |
| U. S. Fish Commission | Washington | Report |
| U. S. Commission of Agriculture | Washihgton | Circular |
| U. S. Geological Survey | Washington | Report |
| Wilson Bulletin | Oberlin Ohio | Bulletin |
| Wisconsin Natural History Society | Milwaukee | Proceedin |

# NOTES ON NEW BRUNSWICK WEATHER FOR YEAR 1905.

BY D. LEAVITT HUTCHINSON.

*January.*—Highest temperature recorded in New Brunswick, 49.7 on 8th, at Grand Manan; Lowest —39.0° on 15th, at St. Stephen.

Exceedingly cold weather; temperatures much below zero were frequently recorded, that of the 15th ranging from 12° to 40° below zero, and in some localities probably lower. The snowfall also was exceptionally heavy, the storm of the 25th and 26th beng the fiercest for many years, completely demoralizing railway and other traffic. Owing to the absence of thaws, the accumulation of snow was unusually deep, especially at St. John, where the snow on the streets had greater depth than had been known for over thirty years; sleighing was good throughout the month, but roads badly drifted. The heaviest gale occurred on the 19th, with velocity of 50 miles an hour from southwest at St. John.

*February.*—Highest temperature, 44.7 on 13th, at Grand Manan, lowest —25.5 on 20th, at St. Stephen, Steady cold interrupted with but a few hours of thawing temperatures, high winds, abundance of snow in drifts of almost insurmountable magnitude, which blocked highways and railways and seriously interferred with movement of supplies, were the principal features of the month. Owing to almost no rainfall, springs and wells in rural dstricts were dry for weeks and cattle watered by melting snow. The highest wind velocity registered at St. John was fifty miles an hour from northwest during the gale of the eleventh, and the total wind velocity for the month was slightly over two thousand miles less than for the same month last year.

*March.*—Highest temperature 61.5 on 30th, at Chatham; lowest —25° on 15th at Sussex. March weather was comparatively mild and very dry with an unusual amount of brght sunshine, no storm signals were displayed and no gales occurred. The last snow fell on the 11th, and the exsessive snow covering gradually

melted away leaving a few patches of ice, but mostly bare and dry ground. There was little movement of river ice, but it has rapidly weakened; the total movement of wind for the month was fifteen hundred miles less than for the same month last year.

*April.*—Highest temperature 73° on 26th at St. Stephen, lowest 19° on 2nd at Dalhousie. The weather of the month was remarkably fine and mild. Precipitation was in all districts greatly below the average. Freshets were unusually light and lumber drives much hindered for want of rain. No storm of importance occurred; wind velocity at St. John measured three thousand miles in excess of April, 1904.

*May.*—Highest temperature 81° on 26th, at Chatham, lowest 11° on the 12th at Moncton. Cool, cloudy and wet weather were the prevailing conditions during the greater part of the month. A heavy frost occurred on the 13th., with temperature well below freezing. Towards the close of the month vegetation in most districts was backward but making good progress.

*June.*—June was comparatively cool and backward with rainfall above the average in most localities. A heavy frost was general throughout the province on the 7th, and considerable damage done to vegetables and fruit. The highest temperature was 92° at chatham, on the 16th, and the lowest 27.5 on 7th at Moncton.

*July.*—Highest temperature 92° at Chatham, on 7th, lowest, 35° at Dalhousie on 27th. The weather was, for the most part, fine and very warm. Near the Bay of Fundy, owing to the prevalence of fogs, it was somewhat cooler, with less bright sunshine. At St. John, southerly winds predominated and some slight damage was caused by lightning on the 27th.

*August.*—Highest temperature 91° on the 12th, at Chatham, lowest, 31° on 15th at Sussex. August weather was decidedly dry with almost continuous sunshine except near the Bay of Fundy district, where fogs were very prevalent during the first half of the month. Light frosts were generally reported on the 14th. Rivers, lakes and wells were unusually low owing to the drought, and forest fires caused destruction of much property in many parts of the province. A general and heavy rainfall was much needed. At St. John southerly winds prevailed during three hundred and ninety-three hours.

*September.*—Highest temperature 83° on 10th at Chatham, lowest, 27° on 30th at Sussex. An exceedingly dull and cool month, with excessive rainfall and few fine days; moderate gales occurred on the 13th and 26th. The total wind movement for the month at St. John was 2000 miles less than for the corresponding month last year. The heaviest and first killing frost was reported on the 15th. Trees retained their leaves but were gradually changing colour. At St. John five and a quarter inches of rain fell between the 4th and the 7th.

*October.*—Highest temperature 81° on 1st at Chatham, lowest 15° on 23rd at Sussex. An exceptionally fine, mild and pleasant month with rainfall far below the average; no gales of importance occurred and the total wind velocity at St. John was 1,100 less than for the same month last year.

*November.*—Highest temperature 58° at St. Stephen, lowest, —13° at Sussex. In general mild weather prevailed, especially during the first half of the month, while during the latter half, although several mild, bright days occurred, the night temperatures were much lower. The precipitation, which fell mostly as rain, was a little above the average. The snowfall was unusually light in all districts, and excepting a light covering in extreme northern localities the ground was bare of snow. At St. John the total wind velocity for the month was fifteen hundred miles in excess of the same period last year. The most important gales occurred between the 15th and 17th and the 28th and 30th. St. John river frozen over on the night of 14th.

*December.*—Highest temperature 55° at Fredericton, lowest, —21° at Sussex. The weather was remarkably fine and mild, and, although the snowfall was comparatively light, sleighing was good during the greater portion of the month. In all localities, temperature averages were much above last year, and severe cold spells, as well as continued high winds, were notably deficient. A most important storm moved into this section on the 10th, attended by the heaviest snowfall of the season, with a wind velocity of 48 miles an hour at St. John, the total wind mileage at St. John was some nine hundred miles less than during December, 1904.

## ST. JOHN OBSERVATORY,

### WIND DIRECTION AND VELOCITY FOR 1905.

| 1905 | N. | | N.E. | | E. | | S.E | | S. | | S W. | | W. | | N W. | | W. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MONTHS | Hours | Miles | Hours | Miles | Hours | Miles | Hours | Miles | Hours | Miles | Hours | Miles | Hours | Miles | Hours | Miles | Hours Calm | Total Miles |
| January.... .... | 194 | 2,078 | 77 | 1373 | 7 | 76 | 29 | 553 | 27 | 518 | 56 | 1,323 | 57 | 898 | 211 | 3,220 | 86 | 10.039 |
| February....... | 118 | 1,207 | 114 | 1824 | 8 | 69 | 11 | 131 | 13 | 138 | 42 | 642 | 53 | 535 | 230 | 3,606 | 83 | 8,152 |
| March......... | 138 | 1,287 | 34 | 250 | 22 | 164 | 50 | 365 | 88 | 808 | 133 | 1,696 | 61 | 637 | 207 | 2,650 | 11 | 7,857 |
| April......... | 115 | 1,339 | 28 | 261 | 29 | 222 | 34 | 491 | 111 | 840 | 170 | 2,720 | 49 | 531 | 178 | 3,046 | 6 | 9,450 |
| May........... | 97 | 934 | 38 | 360 | 72 | 681 | 17 | 156 | 171 | 1,314 | 196 | 2,738 | 29 | 288 | 119 | 2,121 | 5 | 8,592 |
| June. ......... | 55 | 528 | 61 | 689 | 58 | 420 | 49 | 382 | 287 | 1,902 | 101 | 752 | 15 | 66 | 74 | 1,199 | 20 | 5,938 |
| July. ......... | 53 | 387 | 38 | 418 | 54 | 371 | 33 | 246 | 318 | 2,305 | 153 | 1,425 | 32 | 293 | 44 | 5 0 | 19 | 6,015 |
| August ... ... | 85 | 733 | 100 | 888 | 44 | 184 | 15 | 148 | 292 | 1,367 | 86 | 571 | 41 | 147 | 59 | 604 | 22 | 4,642 |
| September..... | 67 | 535 | 56 | 468 | 25 | 168 | 74 | 532 | 134 | 818 | 152 | 1,303 | 21 | 137 | 126 | 2,106 | 65 | 6,067 |
| Octobee.. ..... | 107 | 886 | 61 | 483 | 32 | 279 | 31 | 338 | 60 | 501 | 150 | 2,057 | 49 | 423 | 246 | 3,804 | 3 | 8,771 |
| November ... | 116 | 1,145 | 70 | 465 | 29 | 217 | 35 | 557 | 31 | 652 | 121 | 2,038 | 40 | 410 | 276 | 4,524 | 2 | 10,008 |
| December ... | 150 | 1,094 | 86 | 981 | 15 | 166 | 54 | 793 | 1 | 18 | 31 | 616 | 148 | 910 | 251 | 2,807 | 8 | 7,394 |
| | 1295 | 17,153 | 763 | 8460 | 400 | 3017 | 432 | 4692 | 1533 | 11,181 | 1391 | 17,881 | 595 | 5281 | 2021 | 30,257 | 330 | 92.925 |

## ST. JOHN OBSERVATORY.

Longitude, 45.17 N. Longitude, 66.4 W.

| MONTHS | BAROMETER | | | THERMOMETER | | | *Cloudiness:* 0 = Clear 10 = Wholly Clouded | *Precipitation:* Rain & Melted Snow | Thunder Storms | Fogs |
|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | Highest | Lowest | Mean | Max. | Min. | | | | |
| January.... | 30.03 | 30 77 | 29.22 | 15.8 | 47.5 | —11.0 | 5.0 | 5.77 | 0 | 1 |
| February .. | 29.93 | 30.65 | 29.11 | 16.5 | 37.5 | 3.3 | 5.4 | 2.63 | 0 | 0 |
| March ..... | 30.05 | 30.57 | 29.58 | 29.1 | 51.3 | 1.0 | 4.0 | 1.44 | 0 | 2 |
| April ...... | 29.77 | 30.17 | 29.31 | 40.6 | 63.5 | 25.0 | 6.0 | 1.51 | 0 | 3 |
| May....... | 29.92 | 30.43 | 29.48 | 47.7 | 68.5 | 29.6 | 6.2 | 3.30 | 0 | 0 |
| June.... | 29.92 | 30.26 | 29.54 | 54.8 | 75.6 | 39 7 | 6.3 | 3.94 | 1 | 6 |
| July. ... | 29 94 | 30.19 | 29.55 | 60.8 | 79.6 | 50.0 | 6.2 | 2.88 | 4 | 1 |
| August .... | 29.94 | 30.28 | 29.58 | 59.9 | 75.3 | 46.3 | 6 2 | 2.03 | 1 | 9 |
| September.. | 30.02 | 30.44 | 29.52 | 55.2 | 68.5 | 36.5 | 6.6 | 7.70 | 1 | 10 |
| October.... | 30.04 | 30 56 | 29.53 | 47.2 | 68.3 | 26.6 | 4.1 | 1.13 | 0 | 4 |
| November.. | 29.89 | 30.38 | 29.21 | 36.9 | 52.3 | 12.2 | 5.7 | 5.24 | 0 | 1 |
| December. | 30.00 | 30.76 | 28.91 | 27.5 | 50.2 | 2.8 | 5.7 | 5 20 | 0 | 2 |

The mean height of the barometer was 29.95. The highest reading 30.77, and the lowest 28.91. The mean temperature for the year was 41.0, which is 0.8 lower than average for the past thirty-three years. The maximum temperature was 79.6 on the 10th of July; the minimum —11.0 on January 15. The total precipitation was 42.77, which is 3.21 inches below the average of thirty-three years. First frost occurred on 11th of October, and the last on the 7th of June. Aurora was observed the 24th of June, 5th of July, 26th of September and 14th of November, and at 9.30 p.m. of December 18th a meteor of unusual brilliancy was observed.

D. LEAVITT HUTCHINSON,
Director, St. John Observatory.

# OFFICERS AND COMMITTEES OF THE NATURAL HISTORY SOCIETY FOR 1906.

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### Patron.

His Honour the Lieutenant Governor.

### Officers.

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# BULLETIN

OF THE

# NATURAL HISTORY SOCIETY

OF

# NEW BRUNSWICK.

No. XXV.

VOLUME V. PART V.

PUBLISHED BY THE SOCIETY.

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ARTICLE I.

# NOTES ON THE NATURAL HISTORY AND PHYSIOGRAPHY OF NEW BRUNSWICK.

By W. F. Ganong.

## 101.—On the Physiographic Characteristics of the Tabusintac River.

Read December 4, 1906.

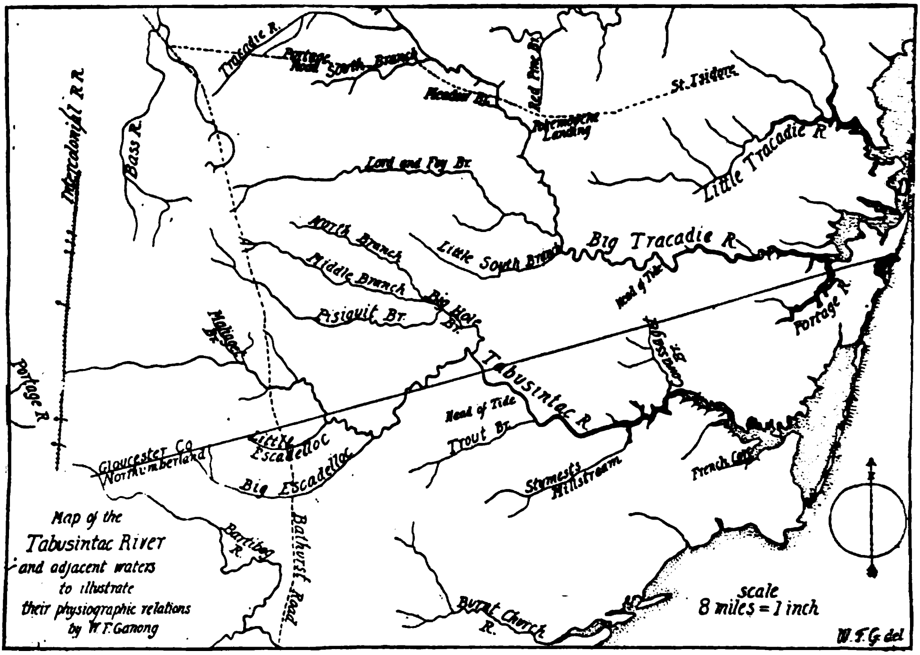
Of the several small rivers draining the northeastern district of New Brunswick, the largest is the Tabusintac. I was able to give it some study during a canoe trip along most of its course in August last, with the following results.

But first we note the development of our knowledge of the river. Its earliest known appearance is upon the Jumeau map of 1685, where it is shown as a small stream with the name *Tabochimkek*.* It persists, with sundry variations, through all the maps of the French period, and also, with more or less erroneous additions, into much later times. The first survey, including the lower settled part, was made by D. Campbell in 1804; then in 1830 James Davidson surveyed it from near the head of tide up to above the Maliaget, and up Big Brook to near the head of its three large branches; but the river through the Indian Reserve has not been surveyed, but only sketched by various surveyors. From these sources, supplemented by some later timber-line and railroad serveys, are constructed our present maps of the river, including that accompanying this paper.

* This word is Micmac Indian, pronounced in that tongue *Tab-oo-sim-kik*. It means "place of two," from *taboosim*—meaning two, and the location *kik*. I have been told by an old resident, and I believe the explanation is correct, that the name is descriptive of the fact that, to one ascending the river, French Cove and the main stream seem to be two large and equal rivers. The other Indian names marked on the accompanying map are all in local use; their significance is uncertain.

A history of the settlements of the Tabusintac is expected to appear in *Acadiensis* for July or October, 1907.

As to other records, they are few. Scientific publications upon the river are well-nigh wanting, being confined to a mention or two in the Geological Survey Reports (Ells, 1879-80, D, 6, and Chalmers, 1888, N.) and a few references in earlier notes of this series (93, 94). Since the river abounds in fine trout, it has been much visited by sporting fishermen, and is mentioned in this connection in various local writings by M. H. Perley, and in the well-known books on fishing by "Barnwell" (Game Fish




of the North), and by Norris (American Anglers Book, 242, 651). It is described briefly, and not wholly correctly, in Cooney's History of 1832. It is settled mostly by English settlers from its mouth to Stymest's Millstream, and was formerly somewhat settled at the crossing of the old Bathurst-Chatham post road. All the remainder of the river is a wilderness, yielding annually much lumber.

The source of the Tabusintac lies near that of the East Branch

of Portage River, in a flat country traversed by the Intercolonial Railway, at the elevation, as shown by the railway levels, of over 450 feet above mean sea-level. Some of its source branches lie among extensive peat bogs, as noted by Ells in his Geological Report for 1879-80 (D. 6). Thence to the Maliaget I do not know it, but all considerations would imply that it is in this extent a clear, swift, shallow stream flowing on a rocky bottom in an ever-deepening and enlarging valley. At the Maliaget, whence I have seen it to the mouth, it is a clear-water stream, 25 to 30 feet wide, rippling along over dark gray sandstone cobbles and gravel, through quickwater pools separated by murmuring rips of small fall. The valley is cut some 60 to 75 feet into a plateau, but is moderately open, though steep walled. The river banks are at times low intervale points; elsewhere the sandstone valley-walls are cut to vertical ledges, and again banks of glacial clay and gravel occur. This character it keeps, but with ever-enlarging details, down to the crossing of the Bathurst road, where the valley is much deeper, some 125 feet, rather more open and very pleasing in its scenery, especially at the clearings of the old settlement. Below the bridge the river continues to enlarge and becomes a pleasing canoe-stream. The bed is still of drift, with occasional ledges, and the river winds much in a rather broad-bottomed valley, turning around low points to wash directly against the valley walls, which it is cutting into vertical sandstone cliffs. In places the plateau seems lower, and in general it lowers somewhat downwards, and thus it continues to the Escadelloc.

It is plain that all this part of the Tabusintac is distinctly long pre-glacial in origin, but the steepness of the valley walls show that it is, nevertheless, comparatively new. It thus harmonizes perfectly with the age implied for it in my discussion of the origin of these Northumbrian valleys (Note 93), namely,—it is not a part of the ancient system, but a newer valley formed upon the southern slope of the great synclinal ridge which forms the backbone of the northeasterly angle of New Brunswick.

Below the Escadelloc, and down to Big Hole Brook, the river, while ever enlarging, keeps the same general character. There is the same constantly moving shallow river, now in quickwater pools, now over shallow rips which merge at times to gentle

rapids, the same varied banks, now low intervale points, now glacial terraces, and again steep sandstone cliffs cut by the oncharging river. Here, too, the valley walls, though far enough apart to permit much minor winding of the river between them, are steep, and cut abruptly into a plateau, which is now somewhat lower and again higher, possibly at times approaching two hundred feet. So far as can be seen from the valley itself, this section of the river is of the same age as that above it. This is an unexpected result, for in my earlier discussion of the origin of the Northumbrian rivers I gave reasons for believing that this section of the Tabusintac ,together with the Big Escadelloc, and as well the lower turn of Big Brook lying in a direct line with it, all occupy a part of one of the ancient Northumbrian valleys. Moreover, I had found this idea to a great extent confirmed when I observed that the Big Escadelloc, where crossed by the Bathurst road, occupied a very wide, deep, ancient-looking valley, a far older and wider valley than that occupied by the Tabusintac on the same road. Accordingly I am inclined to believe that this division of the Tabusintac, from Escadelloc to Big Brook, occupies a valley newly cut, "rejuvenated," into the floor of an older Northumbrian valley, though I admit there are difficulties in this interpretation.

Below the Big Hole Brook the river still continues of the same general character, though ever enlarging and growing gentler in current, while the plateau becomes gradually lower. Then, a mile or two above Trout Brook (and not below it; as shown on the plans in the Crown Land Office), the well-nigh imperceptable current of the river merges with the tide, with hardly a sign to mark their union, save only some water-logged wood upon the bottom. Below the head of tide the valley keeps still the same character, though the tidal stillwaters fill it now to the abrupt walls. Thus it continues down nearly to Stymest's Millstream, when it somewhat abruptly opens out into another character. It is thus plain that all this division from Big Hole Brook, no doubt including also that brook, is of the same age as the parts above the Escadelloc—pre-glacial, and old, but much newer than the ancient Northumbrian valleys.

Comparing the Tabusintac, above the tide, with its sister

stream, the Tracadie, it is evident that the Tabusintac is a more uniform, more monotonous, river than the Tracadie, is shallower and less-pleasing as a canoe stream, but has much less burnt country along it. But, in general, the two are much alike.

At the boom above Stymest's Millstream, the valley broadens somewhat, and on the north side becomes sloping, cultivable and well settled. From this part downward the river is wide, winding, open, well-cultivated upon one bank or the other (usually the north), the opposite being usually steep and rocky, while the country falls off steadily in elevation. All this part of the river is of very attractive aspect, its constant winding and the alternation of well-cultivated with rough wilderness lands making a pleasing prospect. Continuing downward the river gradually becomes wider, and more markedly tidal, and diversified by many inlets, marshes and shallows, while the plateau falls off to a flat well-settled country, until finally it dips imperceptably beneath the sea. Then follows the shallow Lagoon, with its outer bounding beach, such as characterizes all the rivers of this region.

This part of the Tabusintac valley consists of two portions, having different courses. That down to Cowessaget probably belongs, as shown in Note 93, to one of the ancient Northumbrian valleys (The Tabusintian). The part below, however, had a different origin. Noting its direction of flow, which, continued, extends across a great peat bog into the Lagoon, we observe that it stands at right angles to the coast, in this respect being homologous with some minor branches of Tracadie, with the South River of Pokemouche and the Lower Pokemouche itself, with the South Inlet of St. Simon, and with Shippegan Gully and Harbor. It seems very plain that all these waterways are of the same age and origin. If, now, we turn to the charts of the Gulf of St. Lawrence and draw upon them contour lines following the depths, there becomes visible a great trough extending out north of Orphan Bank, in continuation of the Miramichi, and this is obviously the synclinal trough which gave that river some of its principal peculiarities.* Now all the streams above-named point down the slope of this trough, permitting little doubt, apparently,

* On the same charts, it is of interest to note, the great Richibuctian synclinal trough is also plain, extending out between Orphan and Bradelle Banks.

that they were originally formed upon that slope, and worked back at their heads until they intersected the old Northumbrian valleys. Even the lower Big Tracadie and the lower part of the Little Tracadie are very likely of the same age, even though somewhat out of the directions of the other streams. This combination of a series of older Northumbrian with a series of newer Miramichian-slope rivers, seems to offer a logical explanation of the origin of the present valleys of this region.

## 102.—On the Physiographic Characteristics of the Pokemouche and Saint Simon Rivers.

Read June 5, 1906.

Of the five rivers draining the northeastern angle of New Brunswick, two, the Tracadie and Tabusintac, have been described somewhat fully in these notes (Nos. 94 and 101), and a third, the Caraquet, I hope to discuss later. The remaining two, the Pokemouche and Saint Simon, which I have seen throughout their tidal courses, have characteristics as follows.

The Pokemouche rises close to the Upper Tracadie, some of whose waters it must formerly have possessed (Note 94 and the map therewith). Sadler's map of the river, made from survey in 1838, and the basis of all our present maps, records of it: "The banks, with very few exceptions, are low and easy of access, as also in the branches."* Just above the head of the tide the river is clear, shallow, swift, over dark sandstone drift bottoms, precisely like the Tracadie and the Tabusintac, with banks sometimes low and sometimes of glacial gravels. About the head of tide is a fine great clearwater pool, a famous haunt of trout, and beside it, on the north bank, a beautiful low terrace camp-ground between two clear spring brooks. The narrow tideway then winds a mile or two in a flat country and swings northward to the pleasant Maltempec basin, where settlement begins.† Thence

* At the head of the South Branch is a little lake, Gormandy Lake, said to have the peculiarity that on one side its water is good and on the other unfit for drinking.

† A history of the settlement of the Pokemouche is in *Acadiensis* for January, 1907, and a history of Saint Simon will appear under Caraquet in the April number of that magazine.

it turns to the east, and forms an attractive tidal river, winding slightly between well-cultivated, gently-rising banks of considerable elevation, and offering reaches, points and slopes of marked beauty. Indeed this part of the Pokemouche is the most pleasing of any portion of any of the North Shore Rivers, and it will compare well with many a place possessing a far greater scenic reputation. Eastward, the country falls off, and the well-settled, attractive South River enters. The shores of this branch are very low, rising by the gentlest swells from the water, and in places the dead forest trees still standing with their roots immersed by the highest tides afford striking evidence of the rapid subsidence this coast is undergoing. The South River was no doubt originally the outlet of the main stream, which now, however, swings abruptly to the north, cuts through a ridge as a steep-walled and comparatively new (possibly glacial) valley and enters an older valley which evidently headed originally in the Waugh. It then swings eastward as a pleasantly settled estuary, with ever-lowering shores, and fianally reaches the sea through a characteristic sand-barred, low-shored, marshy shallow lagoon.

The Saint Simon above the tide is an insignificant brook, lying, however, in a considerable ripe valley. Its upper tidal part winds about greatly amidst bordering salt marshes as a narrow muddy tidal stream of swift current. It is almost a miniature of the rivers at the head of the Bay of Fundy, and is the only stream of this character known to me upon the North Shore. It swings south and east through a fine deep inlet, with rolling and well-cultivated banks on the south, and receives the low-shored South Inlet, which is separated from Pokemouche only by a peat bog. Then it merges with Shippegan Harbor.

The origin of these two rivers is given, I believe with approximate correctness, in two preceding notes. The upper Pokemouche and main Saint Simon lie in one ancient valley (the Pokemouchian, of Note 93), though I now think it likely its course was through Little Lamec, across the bogs of Shippegan, and out through Miscou Gully, instead of as described in that note. On the other hand, the tidal valleys at right angles to this, including the South River of Pokemouche, the Lower Poke-

mouche and Waugh, the South Inlet of Saint Simon and Shippegan Gully, are all newer rivers of the Miramichi slope, as explained in Note 101.

## 103.—A Downward-forking Brook near Nictor Lake.

Read April 3, 1906.

Some time ago I was told by Mr. Wm. H. Moore, of Scotch Lake, well known to the members of this Society as an observant student of animal life, that his brother, Adam Moore, the leading guide at Nictor Lake, had discoverd a brook which splits into two branches, one of which flows into the Mamozekel and the other into Nictor Lake. Since then he has sent me additional information about it, with a map; and he tells me his brother has confirmed his first discovery by a later visit and more careful inspection of the place, and that it has been seen by others and photographed. According to Mr. Moore's map, the brook is the one shown on the Geological Survey map about four miles south of Nictor Lake, flowing west. One branch runs into South Branch of Mamozekel, as the Geological map shows, while the other branch runs northward into the pond at the source of the little Bald Mountain Brook flowing into Nictor Lake. The stream forks in an alder swamp, and it could easily be dammed by beavers or otherwise so as to send the entire stream down either one branch or the other.

This is certainly a most unusual geographical feature. It requires that a stream descending from one watershed should happen to strike exactly upon the summit of another minor watershed. This entails a coincidence of conditions which must be extremely rare. Morphologically it is much like the occasional instance of a lake which, with an inlet, has two outlets into different systems; but the forking stream requires a much more exactly balanced combination of factors.

## 104.—On the Physiographic Characteristics of the Lower North (or Apskwa) Branch of the Little Southwest Miramichi.

Read December 4, 1906.

The Little Southwest Miramichi, though our maps do not show the fact, is our largest and finest wilderness river. It is formed by the confluence of five great branches, all of which I have had the satisfaction of studying. Four of them are described and mapped in earlier notes of this series (Nos. 55, 86, 87, 99), while an account of the fifth here follows.*

We note first the devlopment of our knowledge of this branch. It appears for the first time, though crudely, upon the Franquelin-deMuelles map of 1686, under its Micmac name *apchkouau*,† and persists, though without name, through maps of the French period. It is first clearly shown upon a modern map from survey on a plan of 1837 by Peters, where it is called simply the *North Branch,* while Berton's plan of the Little Southwest, made in 1838, shows its mouth bearing the name *Little North Branch.* But the first survey actually to touch its waters was made in 1880 by Sadler and Fish, who located Guagus Lake and ran timber lines in the vicinity. A year later Freeze ran the lines which located its headwaters, and since then Fish and McClinton have run the other lines shown upon the map. All of these

* Based upon two visits, one in 1905, described in Note 99, and another in July, 1906. In the latter I was accompanied by my friend, Professor A. H. Pierce. We went on foot (carrying our outfit in packs, and without guides or other aid) from Guagus Lake to and up the Branch, across by the upper portage road to the North Pole Branch, to the headwaters of that stream, Freeze Lake, the source of this Branch, Kagoot, the North Branch Sevogle, and down that stream to the Square Forks and the Northwest Miramichi. From this route we made side excursions in various places.

† Its modern Micmac name is *Ap-oos-kwok,* which is evidently the same word It might well be simplified for use to *Apskwa,* which would form a good and distinctive substitute for the present cumbersome name. *Guagus* is Micmac, and said by the Indians to signify "rough stream." The upper branches of the stream, as I am assured by both lumbermen and guides, have been hitherto unnamed, and I have therefore ventured to apply to them the names of the surveyors who have run the lines in or near the valley. The other names on the Branch are all obviously descriptive, and have been gievn by lumbermen or guides. The stream is commonly known simply as "The Branch," which distinguishes it from "The Pole."

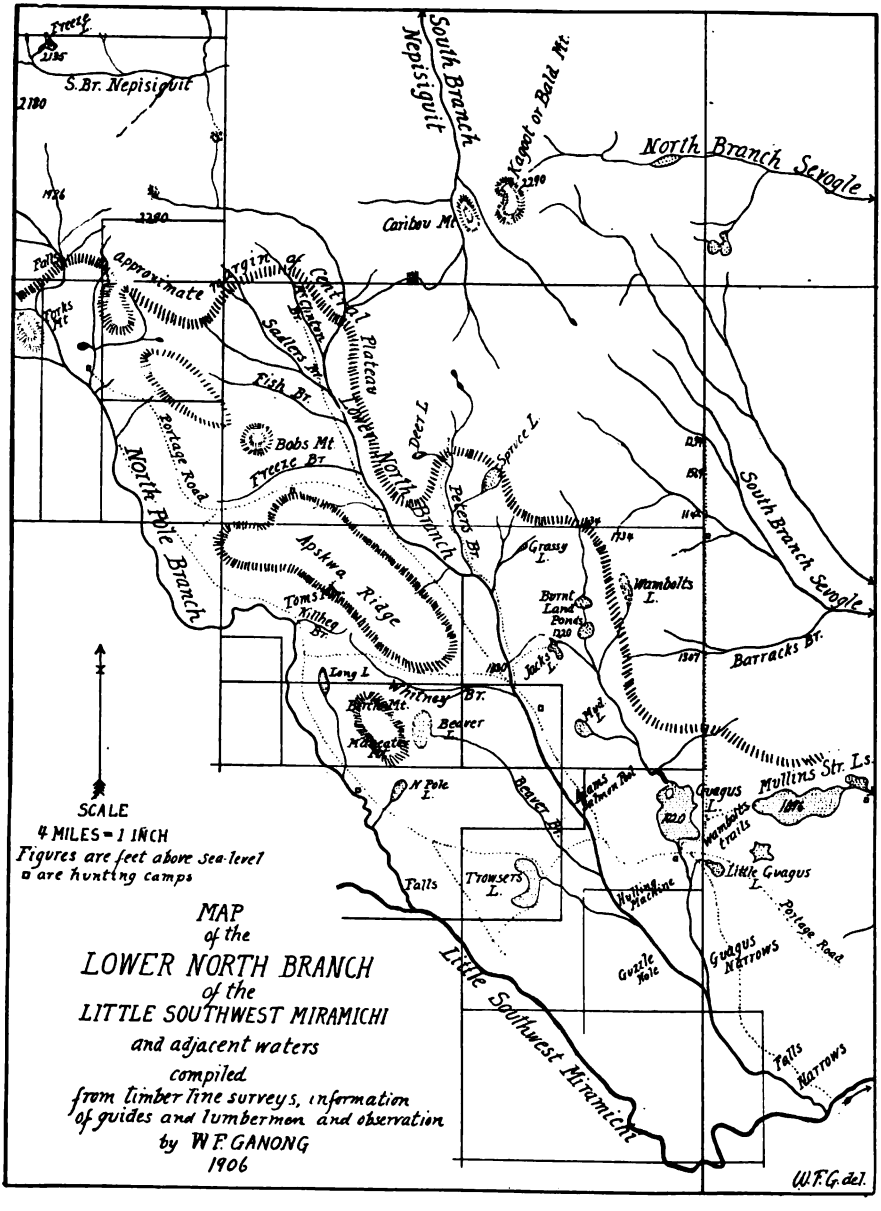
surveys, however, simply located the intersection of the streams with the lines; and no part of the Branch or its affluents have as yet been surveyed, but only sketched between the lines.*

Turning to the printed records, these appear to be altogether absent. No scientific student is known to have visited it as yet, and, aside from my earlier Note, No. 99,† no mention of it occurs in any scientific publication known to me. The boundaries upon the Geological Map are simply sketched by inference from the structure of neighboring regions. Nor do the sportsmen who have hunted here for moose and caribou appear to have recorded their existences, and this is almost the only New Brunswick stream for which some such writings do not exist. It is perhaps needless to add that the valley is wholly unsettled, and the only traces of man consist in the few hunting and lumber camps and the associated portage roads and trails.

The true source of this Branch is shown upon no printed map whatever, and although located correctly on Freeze's plan of 1881-82, it is wrongly attached to the stream entering the South Branch Nepisiguit just west of Kagoot, an error repeated in the general plans of the Crown Land Office. As shown by Freeze, followed on the accompanying map, it rises in two barrens high up on the central plateau in one of the wildest and most remote parts of New Brunswick, and flows eastward across his north timber line. From this point I have followed it downwards for some miles. It is at first a fine clear brook falling much in a V-shaped, heavily-wooded valley cut some 300 feet or more into the plateau. Downwards the fall increases, making the stream

* Hence it would have been in better form to have dotted the streams on the accompanying map, but as all of them are in the same estate this seemed needless. The skeleton of the map is taken from the plans of the Crown Land Office, but for much additional information I am indebted to Mr. John Wambolt, the chief guide on the Branch, and to Mr. Alfred Sinclair, who has lumbered there for many years. Indirectly, also, I have much valued assistance from Mr. Samuel Russell, and from my friend, Dr. R. Nicholson, of Newcastle.

† In my note on the North Pole Branch (Note 99) I ventured the surmise that the main stream above Forks Mountain would be found to wind quietly in a large basin. Nothing could be farther from the truth, as I found by my studies this summer. On the contrary, ascending above Forks Mountain, the stream becomes swifter and swifter, until it is a mountain torrent, pouring down in cascades and falls through a granite gorge from its sources on the surface of the plateau. Half way down it is joined by another stream which gathers all the waters coming from the westward.


MAP
of the
LOWER NORTH BRANCH
of the
LITTLE SOUTHWEST MIRAMICHI
and adjacent waters
compiled
from timber line surveys, information
of guides and lumbermen and observation
by W.F. GANONG
1906
SCALE
4 MILES = 1 INCH
Figures are feet above sea-level
□ are hunting camps
W.F.G. del.
South Branch Nepisiguit
S. Br. Nepisiguit
Kagoot or Bald Mt.
North Branch Sevogle
South Branch Sevogle
Caribou Mt.
approximate margin of Central Plateau
Forks Mt
Falls
Sadlers Br.
Fish Br.
Bobs Mt
Freeze Br.
Portage Road
North Pole Branch
Lower North Branch
Deer L.
Spruce L.
Peters Br.
Grassy L.
Apskwa Ridge
Toms Br.
Kilheg Br.
Wambolts L.
Burnt Land Ponds
Jacks L.
Barracks Br.
Long L.
Whitney Br.
Beaver L.
Mud L.
Mullins Str. Ls.
N Pole L.
Beaver Br.
Guagus L.
Wambolts trails
Little Guagus L.
Trowsers L.
Falls
Hulling Machine
Portage Road
Guzzle Hole
Guagus Narrows
Little Southwest Miramichi
Falls Narrows
2290
1220
1307

almost a torrent, with many rapids, cascades and falls, while the valley deepens, with walls steep in places even to cliffs. At times the fall lessens, and the stream becomes broader, and here occur a great number of new beaver dams and other works, while traces of other large game are abundant, and all signs of man are pleasingly absent. Continuing farther all these features wax larger; the valley is deeper and wilder, the walls are steeper, with some granite cliffs, while the falls are higher, culminating in one of much beauty and great symetery some eight feet in height. Gradually the valley, winding much, swings to the southward; it crosses the Freeze line as the "Brook large enough to drive" of his plans, receives two larger streams in very deep valleys (one of which heads in a barren close to the source of South Branch Nepisiguit), then rapidly lessens in slope to a swift-flowing unobstructed stream, while the country falls off in elevation. Beyond this I have not seen it, but it can have no other course than to issue soon from the plateau, and, as I am told by Mr. Sinclair, it soon unites with other branches about as shown upon the map.

As to the origin of this part of the valley, it seems fairly plain. The drift bed and margin of the stream show it to be pre-glacial, though new; and it represents, I have no doubt, the head of one of the old Northumbrian rivers now cutting its way back into the central plateau.

As the main stream wings into the southeast direction characteristic of the valleys of this region, it receives from the west several large streams, which I have seen at their intersections with the portage road shown on the map. Their approximate sources are located by Freeze's timber lines, and lie, no doubt, upon the slopes of the central plateau, but the larger part of their courses is through a great basin of gently-undulating rocky swells separated by stretches of bouldery black spruce plain and barren, the whole bounded sharply to the northwest and east by the abrupt slope of the central plateau. The lowermost of the affluent brooks, however, as the map will show, occupies a gap between the great Apskwa ridge and the finely-rounded Bob's Mountain leading to the North Pole Branch and followed by the portage road. These branches, like the main stream below them, flow swiftly, now in rough boulder-obstructed courses, now in

smooth sand-bottomed, alder-bordered, beaver-dammed reaches, mostly, however, pleasant and easily canoeable.

This extensive basin is of the same characters as, and evidently homologous in origin with, the basin around Gover Lake, earlier described (Note 87). It was seemingly formed as an ancient circ by the erosion of the many streams which happened to centre here, while in the glacial period it became a sort of catch-basin, which left it deeply floored with drift. But the circ theory finds a difficulty, as it does in the Gover Lake basin, in the great and almost escarpment-like steepness of the plateau margin, some 500 or 600 feet high, whose abruptness suggests either a fault origin, or very unequal erosion of rocks of different hardness. It will require a thorough exploration of this complicated region to settle this interesting question.

The Peters Brook branch, which I have followed to near its source, is a very rapid stream, torrent-like in its upper course, running true south, and receiving branches from the plateau on both sides. It heads up on the side of the central plateau not far south of Nepisiguit waters.

Below the junction of these streams, and down to Whitney Brook, the Branch is a swift, but mostly smooth-flowing river, winding over gravel and small boulders, with a wide, low, bouldery, and largely burnt, plain on either side in a deep but wide, mature, and almost basin-like valley. On the west rises a striking lofty ridge, which must reach to near the plateau level, some 2,000 feet. As this ridge is very conspicuous from different directions, it deserves a more distinctive name than is afforded by the local names attached to parts of it, and I propose to call it by the simplified Indian name for the Branch *Apskwa* Ridge or Mountain. On the east the valley-wall is lower towards the Guagus, and there even seems to be an ancient high gap there. In it lies the bog-bordered Jacks Lake, which has outlets both into the Branch and into Guagus, as I have myself seen. Whitney Brook occupies the larger part of a deep narrow gap extending clear through to the North Pole, and the remainder of the gap is occupied by Killheg Brook, the two streams heading very close together. These great gaps from Pole to Branch must have some significance in the physiographic history of this region.

Below Whitney Brook, I have seen the river only at three or four points, but I infer, from accounts given me by lumbermen, that these represent the general character. In all of these places the valley is narrower than above; the river is rapid and boulder-obstructed, and there is upon one side or the other, or both, an elevated (200-300 feet) flat bounder-plain, extending back to the valley walls which rise gradually to the plateau height. This stony plain, commonly characterized by a growth of black-spruce and heath, is continuous, I have no doubt, with that already described north of Whitney Brook, and is of the same kind as the plains on the North Pole (Note 99). They represent, I take it, the floors of these rivers during the melting of the glacial ice, the rivers being held up to those heights by the dams which created the post-glacial falls and gorges at their mouths. In post-glacial times the rivers have been able to cut down the rock barriers at their mouths, and to cut thus deeply into the boulder plains. Such is the character of the river, so far as I know it, down to the entrance of the Guagus. When it is carefully studied it will no doubt be found to have some such former connection with the Mullins Stream waters, as I have suggested in my note on the Northumbrian Rivers (Note No. 93).

The Guagus occupies a somewhat mature-looking valley heading up on the central plateau and running parallel with the Branch, as shown by the map. In the vicinity of the upper lakes the country is burnt, affording extensive views, and there is a gap through to the Branch, with a two-outlet lake, as already described. One of the lakes, Wambott Lake, is said to be a very clear spring-fed lake high up on the plateau, but the others are shallower. Guagus Lake is a typical New Brunswick woods lake, shallow, with boggy margin on the west (under shelter from the prevailing winds), and boulder margin on the east. It is the most moose-haunted lake I have seen in New Brunswick.* Looking up its length, one can see the Guagus valley extending off far to the northwest, and on the east of it is the great central plateau extending down between Guagus and Sevogle waters almost to the lake. The edge of this plateau then swings off to

* The elevations above sea level of this and the other places on the map have all been determined by myself with aneroid, using the various precautions described in earlier notes.

the eastward, passing north of Mullins Stream Lake, while all the country southward is at a lower level. Between Guagus and Mullins Stream Lake there is an especially low country, which probably indicates a former connection between those two basins. Little Guagus Lake is also typical of the region, shallow, boggy and bouldery. Guagus Stream is said to run throughout its course as it does below the lake—a rapid, shallow stream over boulders, while the Guagus Narrows indicates, probably, a post-glacial gorge. The origin of this system I believe to be, as indicated in my note on the Northumbrian Rivers (Note 93), the upper part representing one of the original valleys, and the lake marking the place where it made its right-angled turn into the Mullins Stream and Sevogle system.

Below the Guagus the Branch is said to be rapid and rough, especially as it approaches the Little Southwest, where occur a series of low falls and rapids, with "Narrows" all apparently post-glacial. Berton's original Survey of 1838 marks it as "very rocky and broken for three miles up." This part of the river is in all probability post-glacial, with a pre-glacial channel into the bend a mile below, as indicated by my earlier note on the Little Southwest (No. 54, page 459).

Reviewing the origin of the Branch as a whole, it is evident that it is homologous with the North Pole, earlier described, and that it includes valleys of three or four ages now all combined into one system. First the remarkable gaps connecting the Branch with the Pole, and their extensions in part to the Walkemik and Guagus, indicate some ancient system of valleys of which they are the remnants. Second, is the principal valley of the Branch, which is also ancient, as shown by its maturity in the face of the hardness of its rocks, and this represents a true typical valley of my Northumbrian system. It is still working back at its several heads into the central plateau, and it certainly had some former connection with the Mullins Stream and Sevogle waters. Third, is the lower valley below the Mullins Stream connection, which is presumably newer than the part above; and lastly, there is the post-glacial connection with the Little Southwest Miramichi. Except for its very head, therefore, this stream has its older parts above and its newer below.

## 105.—On the Square Forks of the Sevogle and their "Interglacial" Testimony.

Read December 4, 1906.

From several points of view the Square Forks of Sevogle is one of the most notable localities of New Brunswick. Scenically, the Forks, with the associated gorges, all readily visible from the surrounding burnt plateau, are strikingly wild and fine. To the sportsman it appeals as including one of the best salmon-fishing privileges in this Province. Physiographically, it offers a curious problem in the unusual and anomalous arrangement whereby two large rivers come together, end to end, in the middle of a single straight gorge, and then turn their united waters at right angles through another. Geologically, it offers testimony, which, I think is conclusive, of fluctuations in the glaciation of the Province, if not indeed of an interglacial period.

Despite the interest of the place, it has as yet received scant scientific attention. The only geologist who makes any mention of it is Dr. Chalmers, who, in his Report for 1888, gives a brief description of the place, with some comment upon its probable origin, and a diagram of the arrangement of the gorges. My own knowledge is based upon a short visit in 1905, and another, in 1906, when I made the accompanying map and observations.

Briefly, the facts are these. As shown by the map, the North the South Branches of Sevogle, the former running in a right-angled gorge, meet in the middle of a straight gorge, then turn at right angles through another, all of a typical glacial type, with steep, often vertical rocky walls, some 50 to 75 feet in height. But this is not all. Closely interlocked with the gorges are other valleys, now dry, but which must have had a part in the evolution of this remarkable place. Thus a rather ripe-looking, drift-bottomed, low-sloping valley lies opposite the gorges on the westward. From it a short gorge or valley, having a rocky bottom (covered, however, with fine drift) above the present water level, extends through to the present gorge, nearly opposite to, but not quite matching, the gorge of the combined streams. Then another valley, hardly a gorge, though very steep-walled in places, and also possessing a rocky bottom above the present

water-level, extends from the right-angled bend of the North Branch through to join the gorge of the combined stream, as shown upon the map, and this valley slopes to the eastward, as shown conclusively by the little stream now in its bottom. It would certainly seem that these two latter-described valleys, with their rocky bottoms at the same level, are of the same age and origin. The problem now before us is, therefore, a double one, for it includes an explanation not only of the meeting of the two rivers midway in the same gorge, but also of the formation of and other valleys.

There are two possible explanations of the meeting of two rivers in one straight gorge,—first, that it is merely a coincidence, and second, that the gorge was formed and occupied originally by a single stream. The chances are immensely against the first supposition, and in favor of the second. If, in the present case, it is possible to combine the latter supposition with an explanation of the other valleys, then it will receive the strongest confirmation. I believe such a consistent explanation of all the phenomena together is possible. I must admit that it is not without its difficulties, and it is very likely that a more thorough examination of the region, especially down the river, where my knowledge is especially weak, may require its modification. But I offer it as a hypothesis fairly consistent with the facts that are known.

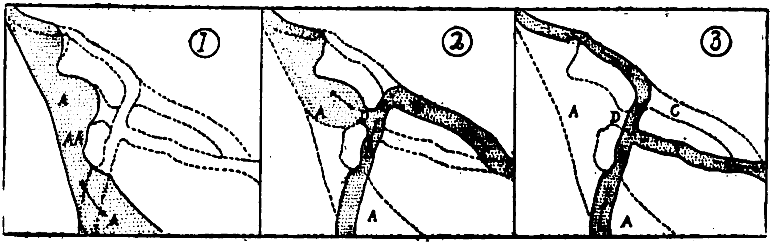
The probable origin of the Forks and Gorges may be expressed in a series of stages.

*First.* Originally the two branches of Sevogle did not come together in this region at all, but flowed independently northeastward as indicated in the earlier note on the Northumbrian Rivers (Note 93).

*Second.* In later times, under the influences of geological causes, a newer river worked back northeasterly from the Northwest Mirimichi until it intersected the valleys, first of the South, then of the North Branch. Thus originated the main Sevogle and part of its North Branch, and it was this river which occupied the "old valley" of the map (A of Diagram). At this time the junction with it of the South Branch lay more to the southward, outside the limit of the accompanying map, where the South

Branch has yet a great bend to the eastward. This stage is represented in the accompanying Diagram 1. I take it the great rocky bends on its eastern shore were formed by the windings of the river around ancient alluvial points extending from the western shore, precisely as all of our rivers in this region are cutting their concave rocky banks to-day.

*Third.* The glacial period arrived, and one of its effects was to choke with drift the Sevogle valley below the original Forks, and as well the old valley at AA of the map, thus forcing the dammed rivers to find new channels, and the Forks to lie in a new position. The lowest outlet happened to lie in the position of the present Gorge BB, and around by the present dry valley C, while the narrow rock mass at the present club house valley (D), afforded the lowest outlet for the North Branch, thus locating




the Forks there. Thus was established the condition shown in Diagram 2.

*Fourth.* There ensued a change in the glacial continuity, whereby both the old valleys, A and C, became choked, leaving the South Branch, BB, unaffected, thereby forcing the North Branch and the combined streams to find new channels, which they did, of course, at the lowest points, which happened to lie where those parts of the two rivers are now running, viz., at E and F. Thus was established the present arrangement, represented (for comparison) by Diagram 3.

*Fifth.* After these conditions had remained uniform long enough for the new channels to be cut below the rock bottoms of the old channels (as they can readily be seen now to be), the dams of drift were washed from the old valleys,—wholly from the old eastern valley C, almost wholly from the western valley A, and in large part from the club-house valley D. I presume

this washing-out took place by action of the great rush of water during the final rapid melting of the glacial ice, after which the reduced river retired into its lowest channels.

Thus can the arrangement of the Square Forks be explained by the aid of a single assumption, that of a fluctuation in the glacial continuity. Such a fluctuation might consist simply of local or limited, backward or forward, movements of the margin of the retreating ice sheet, or it might consist in a distinct interglacial period of considerable duration, of which evidence has been found in Ontario, in New England,* and other parts of the world,† though not yet, I believe, in New Brunswick. There is, however, one fact about these valleys which seems well-nigh conclusive for the interglacial explanation, namely, the old valleys A, C, D must have remained blocked long enough to permit the present gorges to be cut from their tops down to well below the levels of the rock floors of the older valleys, else on removal of the choking drift, the streams would have resumed their courses through the old valleys. Such a cutting, of at least 50 to 75 feet of solid rock, must have required a very long period of time, far longer than could be furnished by an interval between local fluctuations of the margin of the ice-sheet. Moreover, there is other evidence with a bearing upon the subject. On the North Branch of Sevogle, as I have described in a note later to be printed, within three miles above the Square Forks, occur two sets of very fine great gorges, which, while possessing the characteristic glacial-gorge features (including vertical walls), are nevertheless bottomed almost everywhere by drift and occupied by a flood-plained stream much smaller than that which must have formed them. Also in places distinct post-glacial gorges, with falls, occur within the older large gorges. Here, again, there seems to me no way of explaining these double gorges except by the assumption that the larger were formed earlier, and since they are glacial, but neither pre-glacial nor post-glacial, they can only be interglacial.

I am of opinion, therefore, that the Square Forks of Sevogle with the associated gorges present good evidence of the former existence of an interglacial period in Eastern Canada.

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* Compare Science, Vol. 24, 499.

† Compare address on the Interglacial Problem in Nature, Vol. 74, 389.

## 106.—ON THE PHYSIOGRAPHIC CHARACTERISTICS OF THE SEVOGLE RIVER.

Read (in abstract) February 6, 1906; re-written October, 1906.

The Sevogle is our most perfect wilderness river, by far the largest in New Brunswick that is wholly unsettled from source to mouth. It is also one of the least known and poorest mapped, for the reason, no doubt, that all its branches are well-nigh unnavigable, because of their roughness, for canoes, while none of them afford through routes of travel into other streams. In July, 1905, in company with my friend, Professor A. H. Pierce, I descended the South Branch on foot from its source near Kagoot (Bald) Mountain, and in July, 1906, with the same devoted companion, I visited Mullins Stream Lakes, crossed the upper courses ot several branches along McClinton's north timber line, and descended the North Branch from its source. The results of our observations, correlated with other materials I have been able to gether, are as follows.

First we consider the development of our knowledge of the river. It first appears, without name, on the great Franquelin-deMeulles map of 1686, where it is shown heading in a lake near the Lower North Branch, probably Mullins Streiam Lake. It then vanishes not to re-appear upon maps until Bonnor's of 1820, where its lower part is sketched and named Great Sewogle. On Bailliie's

* The name *Sevogle* is Micmac Indian, still in use by the Indians, and pronounced by them very much as it is spelled, but with a sound of the *v* like *w* (making it almost like *Swogle.*) This peculiarity is reflected in the earliest known uses of the name, which sometimes have one form, sometimes another, (Sougle, 1805, Land Memorial; *Sevogle,* do. of 1809; *Sewogle,* maps of 1820 and 1832; *Sevogle,* map of 1824 and later). The Indians do not know its meaning. Little Sevogle is called by them *Mool-mun-an-jeech,* the "Little Mool-mun-aan," which is the Northwest (another form of the name El-mun-a-kun-jeech given by Rand in his Micmac Reader). The names *Kewadu* (said locally to mean Indian Devil) and [*Waubigut*] (said to mean "white foot") are Indian; they appear first upon the Geological Survey map of 1882, and were given to Ells, as he writes me, by a famous hunter and guide, Bill Gray, who had been brought up by the Indians, whom he greatly surpassed in skill. *Sheephouse* may be Indian, (See-bo-o-sis, a brook), though it is locally explained by a story of a hermit who spent a winter there with a sheep as companion. The other names on the Sevogle system are obviously descriptive, and have been given either by lumbermen for some physical peculiarity or person, or by Mr. Arthur Pringle, the principal guide on the North Branch, for various visiting sportsmen. A descriptive name of striking appropriateness is "The Square Forks."

map of 1832 it is made a great river heading in lakes close to the Negoot or South Tobique Lakes. But its accurate mapping had to await surveys, and these were made in 1835 and 1836 by Deputy Peters; they did not follow the river itself, but located many points on its several branches by the intersections of a network of timber lines run every five miles across the lower parts of all the branches in those years. The only actual survey along the stream made anywhere above the Square Forks is a survey of the South Branch from Clearwater to Mullins Stream, made by Garden in 1830. These form the sources of the representation of the river on the published maps of Saunders, 1842, and Wilkinson, 1859. This same plan, extended by sketches of some of the upper courses by Ells and Adams, of the Geological Survey, was the basis of the Geological map of 1882 and of Loggie's map of 1885. Recently many of the old Peters lines have been retraced, and other new lines run by Deputies Hanson, Fish and McClinton. Their plans in the Crown Land Office add much to our knowledge of the headwaters, and have been used in the preparation of the accompanying map, to which facts have also been added from my own observations and from sketches supplied by Mr. Arthur Pringle, Mr. George Estey and Mr. Carl Bersing. Even with all these materials the map is still far from accurate, especially on its southwestern sources, which are scarcely known even to lumbermen, while, except for the surveyed part from Clearwater to Mullins Stream, it is simply sketched, ignoring the windings, between the timber lines. So much for cartography. As for other data they are extremely scanty. I can find no scientific mention of any part of the river prior to 1880, in which year Dr. Ells, or his assistant, now Professor Frank Adams, ascended the South Branch to the Clearwater and visited the headwaters of the North Branch from the Nepisiguit, with results shown upon the Geological map of that section, and briefly described in Ells's report for 1880. Mr. Chalmers ascended it to the Square Forks in 1886, and gives some account of this place and of the river below in his report on Surface Geology for 1888. Professor Bailey, in this Bulletin (XXII, 159), mentions a cave at Square Forks. Other than these, and the preceding note of this series, I can find no reference to the river in any scientific

literature. It has, however, been visited somewhat, especially at Pringle's hunting grounds on the North Branch by sportsmen who have written of their experiences there.* Recently the fall above the Square Forks on the North Branch has been given considerable prominence through the oft-published photograph of leaping salmon taken there by Mr. D. G. Smith in 1901, and published originally in "Forest and Stream" for February 15, 1902. The river, especially about the Square Forks and up the North Branch, affords excellent salmon fishing, the lessee of which has a very comfortable club house at the Square Forks. Originally there was some settlement on the lower part of the river, near the Northwest, but this has been entirely abandoned, so that now the club-house, the lumber camps and the hunting camps of Arthur Pringle, of Carl Bersing and of John Wambolt, with their portage roads and trails, all shown on the accompanying map, are the only human works within the basin.

The Sevogle is noteworthy for the remarkable spread of its great branches, which radiate fan-like from a centre at the Square Forks to fill the great quadrangular space enclosed between the Little Southwest Miramichi, the Lower North Branch, the South Branch Nepisiguit, and the Northwest Miramichi. For practical purposes, and including the Little Sevogle, the branches may be divided for description into several groups, as follows:

*The Little Sevogle.*

This stream I have nowhere seen. But I have been told by two lumbermen who know it, that it is a quiet stream, with considerable deadwater upon it, and elsewhere shallow and smooth-flowing, with only one small fall near its mouth. These characters

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* The first was Dashwood, who visited Kewadu Lake (apparently) in 1868, coming through from Nepisiguit, and out by the Northwest; he tells of his trip in his charming book "Chiploquorgan" (49, 52). Accounts of hunting trips from Pringle's camps have been published by Risteen ("Prowler") in *Forest and Stream*, Jan. 19, 1895, 46; by E. A. Slack in the same for Mar. 13, 1897, 206, (he visited Indian Devil, our Kewadu Lake), by Geo. McAleer in the same for Nov., 1905, 667, by W. T. Chestnut in *American Field*, Nov. 5, 1904. An account of a hunting trip to Peabody Lake by G. F. Dominick is in *Forest and Stream* for Feb. 1, 1902, 82, and a narrative of another to Clearwater Lake, by F. G. Harris, is in the same journal for Oct. 20, 1906, 612. An account of the survey of McClinton's North Line, by J. H. Sweet, is in the *University Monthly* for Nov., 1898.

would accord wholly with the theory, given in Note 93, that this valley is a part of one of the old Northumbrian system, and that through it the Little Southwest below the Lower North Branch continued its course to the eastward.

### *Mullins Stream.*

This stream heads in Mullins Stream Lakes, a well-known hunting region, which I have seen. The lake is open, and apparently moderately deep, with low bouldery shores, but higher valley walls (especially to the north), and a gap to the westward towards Guagus Lake. The lower lake is similar, and below that is a great deadwater, below which I have not seen the stream. I have been told, however, that it is a shallow rocky stream, almost lacking in fish, and that its chief feature is a fall of several feet situated just where the North Branch enters it.

Thus all the data I have about this stream accord fully with the physiographic history sketched in Note 93, that the Guagus valley swung through the lakes and eastward into the South Branch Sevogle, while its main stream carried the waters of the Lower North Branch.

### *The Western Branches.*

As the map clearly shows, several large affluents of the South Branch rise close over towards the basin of the Lower North Branch. I have been able to see all of these, and the lofty intervening country, along McClinton's north line, which I have followed from Guagus Lake to near the Little North Branch. I have also followed the west line to near the source of Guagus Stream. As may be clearly seen from the summit of Kagoot and elsewhere, all the country on and west of the line is a lofty plateau, an extension of the great central plateau, deeply cut by the valleys of the stream, which are cutting their way back northwesterly into it.

The first Sevogle water on the line north from Guagus is Barracks Brook (the stream south of it being wrongly shown on McClinton's plan as running east); it is here a quiet stream in

a deep but not narrow valley, 1,307 feet above the sea,* with a drift bottom much wider than the stream, and an open appearance to the westward. The comparative ripeness of this valley suggests that it may represent a part of the ancient Northumbrian system, perhaps having a former connection with the Branch. A little to the north is a small branch of this stream, and beyond that comes a clear beautiful mountain torrent, evidently new. Then beyond the west line lies the main stream of the South Branch (1,142 feet elevation). This is a swift stream, too small to keep itself clear of driftwood, falling over ledges in a narrow valley. Evidently it is a new stream cutting into the plateau, and its head cannot be any great distance to the northwest. North of this comes another somewhat larger, but otherwise similar, Branch (1,294 feet above the sea). Its brownish water indicates the presence of bogs on its upper course, a supposition confirmed by a statement given me by Mr. Estey. I think it very probable that this stream heads to the northwest close over to waters of the South Branch Nepisiguit, and some traces of such a valley can be seen from the summit of Kagoot. It is furthermore possible that this valley had a former connection with the South Branch Nepisiguit, and that the valley now emptying eastward opposite Kagoot may be the original head of the Sevogle.

*The Little North, with the main South Branch.*

We consider now the Little North Branch which we descended. It rises close up to Kagoot, or Bald, Mountain, and some of its upper courses lie in an open country with extensive open barrens. At the crossing of Pringle's trail the main stream is a pretty little clear brook five feet wide and 1,552 feet above the sea. It then flows southward in a country at first flat, but later becoming cut by deepening valleys, and receives sundry clear branches, especially from the eastward. We missed its immediate junction with the dark-colored North Branch, but followed it from just below that point to the South Branch. It seems to run, as a rule, close against a high valley wall on the southwest, but with more open country to the northeast. It acquires considerable and increasing fall, over a gravelly and later bouldery bottom,

* All elevations mentioned in this paper are from my aneroid measurements, made as described in earlier notes.

becoming finally very rough in a narrowing valley down to its junction with the South Branch, 950 feet above the sea. At the junction the South Branch is much the larger stream, perhaps twice as large, and runs in a distinct valley of its own against a plateau wall on the south. Evidently it is the main stream, while the North Branch enters by a newer valley, the upper part of which may originally have entered the Clearwater valley by a route suggested by the map.

Below the junction the enlarged river runs in a somewhat deep winding valley, with occasional ledges on one side or the other, and a bouldery bed of much drop. Such is it down to the Clearwater, 717 feet above the sea. This stream is not a fourth the size of the main river, shoal, warm and very clear. The main river itself has now become surprisingly large, carrying even at lowest summer level an ample amount of water for canoeing. But throughout the length of Sevogle, canoeing would be next to impossible because of its shallowness, roughness and incessant fall.

Below the Clearwater the Sevogle continues of much the same character as above, though with everything upon a large scale, except the height of the valley walls. These gradually fall off until they do not exceed 100 feet in height, though the valley walls, sometimes forming great cliffs, still continue steep, forming a sharp edge with the plateau. The valley is always drift-bottomed, and clearly all pre-glacial in age. Two miles below Clearwater occurs a great bend of the river to the eastward, a bend which represents one of those great turns so characteristic of all the old Northumbrian rivers, as I have earlier shown (Note 93). Then it keeps the same general character down well-nigh to Sheephouse Brook, when there appears on the north bank a grand semicircle line of great cliffs, at the end of which the valley suddenly narrows to a typical short post-glacial gorge (the Narrows), with extinct fall. I could not determine the position of the pre-glacial channel, which I suspect is on the north bank behind the line of cliffs. Half a mile below the Narrows comes in Big, or Sheephouse, Brook, a very long stream with apparently a post-glacial mouth. A little below is Little Sheephouse Brook; three miles up this stream is said to occur a fine fall

of some sixty feet in height, not truly vertical, but of several leaps. Below these streams the country opens out somewhat, and the plateau becomes lower, though the river continues swift, broken and shallow. Mullins Stream enters by a narrow stony mouth, and very probably its original course was farther south, as mapped in Note 93. Finally, passing into an extensive burnt Princes Pine country, the river, never relaxing its swift stony character, reaches the gorges of the Square Forks.

We note now, the probable origin of the streams belonging to the South Branch. Their characters and directions make it seem plain that they are long pre-glacial, and in their lower courses parts of the ancient Northumbrian system of valleys. That they are smaller and look less ripe than the old parts of the Lower North Branch and North Pole is due probably not to a lesser age, but to a lesser drainage basin. Like other rivers of that system they are still working back at their heads into the central plateau, and they have no doubt undergone many subsequent changes, whereby some branches have been thrown from their older courses into new and shorter ones. But the elucidation of these questions must await more detailed study.

### *The Clearwater and Sheephouse Branches.*

Of these I know nothing more than is stated above and shown by the map.

### *The North Branch.*

The North Branch of Sevogle rises on the easterly slope of the Kagoot, or Bald, Mountain plateau, very near to a principal source of the South Branch, and starts eastward through an open burnt country. This open country is part of a curious area stretching northward clear through to the northwest, and including the remarkable broken area about the source of that river, described in an earlier note (Note 78). In this area the original plateau has been carved down to a kind of long basin, with low ridges separating very irregularly-running valleys, eastward of which the original plateau still exists. The North Branch is at first a very sluggish dark-colored stream of alternating deadwaters and boulder rips, increasing somewhat in slope and current

as it enters a more definite valley a little above the entrance of the stream from Kewadu Lake.* Below that it runs in a rather narrow and deepening valley, becoming a rocky stream of much fall, showing many cascades over ledges and even some approach to small gorges. Receiving some small streams it gradually becomes quieter in a widening valley, and receives the North Fork in a very pleasant open alder and intervale basin.

The North Fork rises in a group of attractive little wilderness game-haunted lakes, as shown upon the map. The stream, mostly dark and quiet, with deadwater reaches, flows eastward with a low ridge upon its southern and a plateau upon its northern side, and joins the much larger main stream, as shown upon the map. Below the junction the stream swings to the south and occupies a valley of some depth and maturity, with a drift floor of considerable width. Downward the valley becomes deeper and the stream swifter. There is then a gap in my knowledge of it (owing to our following a portage road); I saw it next on its easterly bend, and there the valley is very deep, winding and narrow, while the stream falls much over frequent ledges, which culminate in the fine vertical fall of some eight feet just above the Little North Branch. All this part seems newer than the parts above, indeed almost of "interglacial" character, and I believe the valley above must have had a former course across in an easterly direction to the Northwest, while this lower part is much newer.

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* The characters of the lakes I have seen are as follows: *Kewadu* (or Slacks) lies in a flat wooded country, has bog, marsh, boulder and sand shores, with a bouldery schist island on the west side joined by bog with the shore. Originally (very likely pre-glacially) it must have emptied southward instead of north, as now. The Moose-pond is a shallow moose-haunted boggy deadwater. Canoe is a pleasing lake, with rising wooded shores and grassy margin, while Riordan's is a woods lake with stony shores. Neds Lake is a very attractive little woods lake with high shores, and Allan Pond is of similar character, but possessing a remarkable margin of firm grassy marsh. This same feature, which I have nowhere else seen so well developed, appears in Musquash Lake, while Big Lake, just above the latter, lying high up on the plateau, is a very pretty, beaver-haunted lake, with finely forested rising shores. The winding grassy Deadwater on the North Fork is almost a lake, and lies against a high ridge on the north; it is a centre for immense numbers of moose, and is, I think, the lake called *Waubigut* on the Geological Survey map. All of these lakes have been dammed of old by beaver, and they formed a great hunting ground for those animals. Traces of an old Indian hunting camp and a trail, supposed to have been made by Bill Gray, were found in the vicinity of Camp Waite by Mr. Pringle when he first began hunting in that country.

The Little North Branch, which is said to have a fine broken fall of nearly sixty feet in height three-quarters of a mile up from its mouth, is a large clear stream. Below it the valley continues for a time of the same deep rocky, almost "interglacial" character, its valleys cut some 300 or 400 feet into the plateau. But gradually the valley opens out, the country begins to fall off, and the whole appearance of the river indicates greater maturity. The river bed, with its clear brown water, continues everywhere of the shoal, rocky-obstructed, much-falling type which is so characteristic of the entire Sevogle system. Near the foot of this southeasterly stretch come some cliffs, and then the river plunges into the Big Narrows, an irregular, wild post-glacial gorge with a broken fall of four or five feet near its upper end. A little below it receives Peabody Lake stream, coming from Peabody Lake, a famous place for trout, and swings to the eastward. It then becomes less winding, more open with a lower plateau, with beaches and intervale banks, and all the signs of considerable maturity. These characters become more marked around its northerly turn; and then to the eastward, just before swinging south, the river enters a fine great gorge, or series of gorges, cut through soft rusty slates into a flat plateau, with often vertical walls one hundred feet in height, which extends for three-quarters of a mile or more, and constitute the finest I have seen in New Brunswick. But, aside from its fine scenery, this gorge possesses another feature differentiating it from any others known to me in the Province, namely, it is not of post-glacial formation. This is, I believe, clearly shown by the fact that it is much wider than the bed of the present stream, which runs through it almost entirely over drift, and with low intervale points or a narrow flood-plain upon one side or the other; while in addition its falls do not occur at its head, but at various points, and especially near its foot at a place where a true post-glacial gorge occurs within the older and greater gorge. That they are of glacial origin all their characters show, and since they are not post-glacial, I have no question that they are of truly "interglacial" origin, as has already been noted (Note 105). Below this gorge the valley becomes again open and the river wide and shallow for a mile or two, when it enters yet another interglacial gorge with a fine

post-glacial fall of some nine feet in height near its foot, having great salmon pools below it. Then the valley is again open for a little, but very soon another gorge is entered, leading to the Square Forks. Here it joins the much large South Branch. But this locality is of such special interest that I have already described it in a separate note (No. 105).

We consider now the origin of the South Branch. The origin of its sources is complicated by their presence in the curious broken country east of Kagoot, but they appear to be old rivers which very likely had an early course eastward into the Northwest. The southerly courses down to the Lake Branch appear to be of comparatively new, perhaps "interglacial," origin. But below Lake Brook the valley seems older, and is probably one of the Northumbrian series which formerly swung northeast until captured by the Big Sevogle, which extended back farther after capturing the South Branch. (Compare Note 105).

Below the Square Forks the river flows for a mile and a quarter in an extensive gorge, from which it issues to become a wide valleyed, intervaled and terraced, swift-flowing stream, such as is characteristic of all our rivers in the Carboniferous formation. This part of the Sevogle, if I read the collective evidence aright, is newer than the northeast-southwest valleys of this region, and owed its formation to the causes which produced the north and south (Minaqua) part of the Northwest near by. (Note 93).

ARTICLE II.

# NOTE ON ARCHÆOZOON.

BY G. F. MATTHEW, LL.D, F.R.S.C.

Read 4th Dec., 1906.

In the year 1891, the writer of the following note, then President of this Society, brought before it certain discoveries relating to organisms of low type found in the ancient rocks around St. John.

This was partly in the presidential address of that year, and partly in an article on "Eozoon and other low organisms in Laurentian rocks at St. John." *

In part these two papers relate to the genus Archæozoon, examples of which had then lately been brought to the writer's attention. As this organism was subsequently found in other localities than that from which it was originally described, and as a similar organism has recently been found in the Pre-Cambrian rocks in the Rocky Mountains by officers of the U. S. Geological Survey, and has been figured in a Bulletin of the Geological Society of America by Hon. C. D. Walcott, Director of the above-named Survey, the present seems a fitting time to gather up the information relative to Archæozoon and present it before this Society.

In the presidential report above cited, Archæozoon is referred to in the following terms: *

" The second horizon of organic forms is in the upper limestones of the Upper Series (of the Laurentian area of rocks in the vicinity of St. John). The organism found here . . . . . is one of the calcareous coral-like structures, somewhat like certain forms found in the basal beds of the Cambrian (and of the Ordovician). Its structure has not yet been studied, but *en masse* it consists of elongated cylindrical objects, which are from one inch to

* Nat. Hist. Soc. of N. B., Bull. IX, p. 32, par. 3.

three inches across, and several inches in length (described further on as *Archaeozoon Acadiense*). The object consists of a cumulative growth of conical partitions, layer upon layer, building up a cylindrical body that in cross-section looks not unlike a part of a tree-trunk, and which bears a general resemblance to *Stromatopora rugosa*, Hall. The upper limestone, at the base of which this organism is found, has suffered greatly from denudation, as we find areas of the 'Upper Series' which do not appear to have the upper limestones. Good examples of the fossil are known only from one locality."

The part of the article on "Eozoon and other low organisms at St. John," referring to Archæozoon, is as follows:

"Some months since the attention of the writer of this communication was called by Mr. Wm. Murdoch, C. E., of St. John, to the appearance of some fragments of crystalline limestone which were thought to be pieces of petrified wood. The fragments had been broken from ledges at a locality ('Green Head') in the Upper Series of the Laurentian area (of rocks) near St. John, N. B.

"These fragments had apparently a concretionary structure, but differed from any concretionary limestone the writer had seen before. The pieces exhibited were not sufficient to show the nature or origin of these apparent concretions, and an early opportunity was embraced of visiting the locality and making observations on the spot. This visit resulted in the discovery of an extensive reef of limestone, in which immense numbers of these peculiar fossils are preserved in a remarkably perfect condition.

"The reef began its growth on a bottom of fine sand, now converted into a quartzite rock, which forms an important part (member) of the 'Upper Series.' There (at the bottom of the reef) the object consists of a multitude of small, short, closely set columns, which grew tier upon tier, with at first more or less sand between the tiers.

"It may be observed, also, that these crowded clusters of columns were often cut off over considerable areas by thin horizontal layers of (amorphous) mineral matter, perhaps indicative of the incursion of (fine) sand or other sediment, but the

growth was almost immediately renewed by a new set of columns, occupying the fresh surface of mud that covered the old ones.

"In the upper part of the reef in which the columns flourished and grew luxuriently, it is very interesting to observe the apparent effort put forward by some of these columns to overtop their fellows. Those that grew most vigorously would spread and crowd the adjoining ones, so that they were compelled to elevate the centres of their calcareous layers. Thus in these crowded columns the layers became almost (inversely) funnel-shaped, while in the broad ones, that had plenty of room to grow, they flattened out to an (inverted) saucer shape, or in some cases are almost entirely flat. It is these funnel-shaped layers which, when they are cut across, have the appearance of the ends of sticks of wood. They have thus given to unpractised observers the impression that the rock consisted of crowded masses of wood turned to stone.

"Sometimes one of these columns was quite crowded out of existence by its more vigorous neighbors. In other instances we appear to have cases where the columns bifurcated, and formed two columns to occupy a space otherwise vacant on the sea bottom. Another feature of these columns, which helped to carry out the deception that led those who first saw the rock to suppose that each column was a stick of wood, was that the silicious* (dolomitic) layers are thinner, and sometimes fail altogether at the centre of the column. As the spaces between the calcareous layers are filled with mineral matter of a darker hue than the calcareous substance, (and the centre of the columns is also of a dark color), the columns appear to have a dark centre, like the pith of a tree; hence they were thought to be the trunks of 'hardwood' or exogenous trees.

"This reef of calcareous columns was about one hundred and fifty feet deep, but its lateral extent is not known, as it is cut off on one side by a fault, and on the other passes beneath the waters of the St. John river.

"A peculiarity of these calcareous columns is that they are usually surrounded by a casing of more magnesian substance; thus a space of a quarter of an inch or more may separate two

* Prof. F. D. Adams, who has examined these layers, says they are dolomitic.

of these columns, this space being (partly) filled with an irregular and broken calcareous or calcareo-magnesian deposit.

"The microscopic character of these columns and the layers has not been studied, but to the naked eye the more dolomitic layers, when well preserved, are distinctly beaded, as if they were filled up chambers of an organism in which the chambers were imperfectly separated from each other.

"A peculiarity of this object is that of the sudden cessation of growth, either of a part, or of the whole, of an individual column. In a case of this kind the space thus left vacant is occupied by the extension over it of the layers of a neighboring column, or by the growth of one or more new individuals on the senile surface.

"These new columns have in all cases a dome-shaped or hemispherical form, which they retain until they are as large, or larger, than a finger-end, after which the layers begin to flatten.

"There is a fossil described by Professor James Hall (*Cryptozoon proliferum*) occurring in the Calciferous rocks at Greenfield, N. Y., which at first glance strikingly resembles the Acadian fossil above described,* but it differs in the mode of growth, as it consists of rosettes of various sizes, consisting of concave laminæ (while those of *Archaeozoon Acadiense* are convex)."

This is all that was published about this peculiar fossil at the time it was first investigated. But two years afterward Dr. W. D. Matthew, then a fellow of Columbia College, New York, undertook an examination of the "Crystalline rocks near St. John," and in the course of his investigations met with this fossil in the limestones of the "Upper Series" in the peninsula north of the city of St. John, on the shore of the "Narrows" of the St. John river.† The locality is in the same basin of limestones as that containing the typical forms from Green Head.

In 1894 another locality for this fossil was discovered by Mr. Geoffrey Stead on Douglas avenue, on the ridge between the harbor of St. John and the river St. John above the "Falls." The fossil here is not quite at the base of the limestone, but is not far from it, and the individuals are smaller than many of those seen

* See 36th Ann. Rep. N. Y. State Mus. Appendix.

† Nat. Hist. Soc. of N. Bruns'k, Bull. XII, p. 16.

at Green Head. This locality is in a more southerly basin of the limestones of the "Upper Series" than that of the Green Head locality, and the locality where it was observed by Dr. W. D. Matthew.

The latest occurrence of the fossil noted was at Black River, on the coast of the Bay of Fundy, eastward of St. John, and quite detached from any known area of Laurentian rocks. It occurs at the side of the road leading from Black River to Loch Lomond as small boulders in a conglomerate at the base of the red Devonian rocks of the latter place. Extending from the point where this occurrence was observed, for several miles to the westward, is a ridge of gray grits, which may be a coarser form of the quartzites of the "Upper Series" of the Laurentian area seen around St. John. If this ridge is of the "Upper Series," the position of the Archæozoonal limestone would be along its southern face, against which the Devonian rocks now rest, and which may therefore be supposed to cover the Laurentian limestones if present at this place. *

The resembling fossils found by Mr. Bailey Willis, of the U. S. Geological Survey, in northwestern Montana, have been observed in a limestone of Pre-Cambrian age, called the Siyeh limestone, and have been named *Cryptozoon frequens*. The excellent half-tone reproductions of this fossil show how close they are in general structure to *Archaeozoon Acadiense*, especially in their convex growth and in the spaces between the columns. The microscopic structure of *Cryptozoon frequens* is not described in the paper I have cited, and there is no further means of comparison with the Acadian (Canadian) fossil; but that Pre-Cambrian limestones in the Rocky Mountain region, clearly shown to be such by their relation to a well-defined Cambrian terrane, should contain organic structures so like the Archæozoon, is an important and suggestive addition to our knowledge of the earliest forms of life.

* Bull. Geol. Soc. of America, Vol. 17, pp. 4, 6, 8, 10, 11, 19, pl. 19.

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# EXPLANATION OF PLATE

FIG. 1.—Geological sketchmap of the vicinity of St. John, N. B., (from the map of the geological survey) showing where Archæozoon has been found.

Areas occupied by Pre-Cambrian schists and intrusives. (Marked by small crosses).

Pre-Cambrian limestones, the large area is not continuous as represented. (Marked by dots).

Cambrian (and Lower Ordovician). (Marked by vertical lines).

Little River plant-bearing terrane. (Marked by horizontal lines).

Overlying red conglomerate and shales. (Marked by circles).

Localities where Archæozoon has been found. (Marked by large crosses.

N. B.—the locality at Black River is outside of the limits of this map (to the S. E.).

FIG. 2.—(The original figure of this form published in Bulletin IX, 1880). It is a vertical section of Archæozoon Acadiense, one-half diam. It shows well the alternating convex layers of a single column. From the Upper Series of the Laurentian area at Green Head, St. John Co., N. B.

FIG. 3.—Horizontal section of this species, one-seventh diam. It shows the spaces between the columns filled with a magnesian deposit. After the hardening of the limestone mass it suffered somewhat from lateral squeezing and from faulting, and the columns were somewhat broken up.

N. B.—The parallel striation on the surface of the rock is due to the saw. From Green Head, St. John Co., N. B.

FIG. 4.—Vertical section of a group of weathered columns of Archæozoon Acadiense one-sixth diam. This shows the origination of a colony of Archæozoon on horizontal layers of calcareous mud; at first the growth was irregular and sporadic; then gradually developing distinct vertical columns, the margins of the columns are indicated by a pale gray coloring; in the upper, more weathered portion of the block, the convex layers of the fossil are more distinctly visible. From limestone of the southern basin of the Upper Series at Douglas Avenue, St. John, N. B.

ARTICLE III.

# SEPTEMBER AMONG THE GAME BIRDS OF MISCOU ISLAND.*

By J. Orne Green, M. D.

It has been my fortune to have spent every month of September during the last twenty-eight years on the Island of Miscou in camp on "the moss" of the eastern end of the island. I have always arrived on the island about August 26th, and have left about September 27th, and whatever value the following observations have is due to their being confined to this season extending over many years. The accompanying is a full list of the game birds observed:

Tringa canutus. Knot. Red-breasted Sandpiper. Gray-back.
" maculata. Pectoral Sandpiper. Grass Bird.
" fuscicollas. White-rumped Sandpiper.
" minutilla. Least Sandpiper.
Ereunetes pusillus. Semipalmated Sandpiper.
Calidris arenaria. Sanderling.
Limosa haemastica. Hudsonian Godwit. Ringtailed Marlin.
Totanus melanoleucus. Winter Yellow-legs.
" flavipes. Summer Yellow-legs.
Numenius longirostris. Long-billed Curlew. Sickle-bill.
" Hudsonicus. Jack Curlew.
" borealis. Eskimo Curlew. Dough-bird.
Charadrius squatarola. Beatle-head. Black-breast.

* Dr. Green is a resident of Boston, a retired professor of the Harvard Medical School. His many long visits to Miscou were in part for sport, but chiefly for the free wild outdoor life that island permits. This paper was prepared in 1905 so that his twenty-eight years of knowledge of the island extend back to 1877. The various localities of which he speaks may be found marked upon the physiographic map of Miscou Island in the preceding Bulletin at page 450. "The moss" is the same as the "moors (barrens") of that map, which shows the two Malbaies and Big Lake, while Little Shippegan Harbor is the same as Miscou Harbor. Dr. Green's camp at Miscou was on the eastern side of the little stream shown by the map as emptying a tiny lake into the northern end of Malbaie South. Dr. Green has purchased a farm at Tweedside, near the Northwest Oromocto Lake, where he intends to spend his summers in future.—Editor Bulletin.

Charadrius dominicus. Golden Plover.
Aegialitis semipalmata. Ring-neck.
Arenaria interpres. Turn-stone.
Gallinago delicata. Wilson's Snipe.
Merganser serrator. Sheldrake.
Anas boschas. Mallard.
" obscura. Dusky Duck.
" Carolinensis. Green-winged Teal.
" discors. Blue-winged Teal.
Dafila acuta. Pintail.
Glaucionetta clangula Americana. Whistler. American Golden-eye.
Branta Canadensis. Canada Goose.
" bernicla. Brant.

The red-breasted sandpiper arrives about the first of September and is found in considerable numbers till about the 20th of the month. Specimens in the summer plumage with the rufous brown abdomen are rare; certainly nineteen-twentieths are in full ashy-gray winter coat.

Grass birds breed on the island and the small young birds are always found on the salt-marshes. The northern flight of mature birds rarely arrives before the 15th of September and often not till the 25th or later even, and the numbers vary very much in different years. They remain usually but a short time, but in some years the salt marshes are fairly alive with them during their short stay.

The white-rumped sandpiper and the least sandpiper are the most abundant of any of the shore birds. They are present in large flocks in August and continue so till about the 20th of September. Sanderlings are never seen in large numbers; they are generally late in arriving, about September 10th to September 15th.

The ring-tailed marlin years ago was not uncommon although never seen in large flocks. In the eighties, a few specimens were shot every year, but in the last fifteen years I do not think I have seen more than one or two, and certainly none for the last ten years. It was formerly their habit to fly from the seashore to the muddy banks of the freshwater ponds at dusk, where they apparently passed the night. Yellow-legs are fairly abundant although never in very large flocks; they remain through September.

The large sickle-billed curlew has apparently disappeared. In 1878, I saw two specimens, one on Peters River near Bathurst, and one on Miscou Island, but since then none, nor can I get any authentic record of one.

Jack curlews are the only birds of which I can say their numbers have not vastly diminished during my twenty-eight years of residence. Never in large flocks but in collections of two, four or even ten, they are scattered over "the moss" from August to September 15th or 20th, but the majority do not arrive till September, and their stay on the island is wholly dependent on the quantity of blueberries. With an abundant berry crop they remain till driven off by the northerly and easterly September gales; with a small crop they simply explore the island and pass on. On arrival they are always in very poor condition, but a few days with the blueberries puts them in the best of condition.

The mention of the eskimo curlew or dough bird must bring a pang of regret to all naturalists, sportsmen and epicures, for it is apparently rapidly disappearing. When I first knew the island they were present in flocks of twenty to fifty or seventy-five all over "the moss," arriving often before the middle of August and remaining till about September 15th, always arriving earlier and leaving earlier than the jack curlew, and usually flying in company of the golden plover. Up to 1890 they continued fairly abundant; since that year they have steadily and rapidly diminished in numbers, and for the last eight years have been rare. Several seasons of late none have been seen, and in the last five years I do not think I have seen as many flocks. Usually of late a few isolated specimens, mingled with the shore birds and not among the blueberries, has been my record.

What has been said of the dough birds will apply almost word for word to the golden plover, except that the numbers of the latter were noticed to be rapidly diminishing for several years before the loss of the dough birds was observed. The majority of the birds were already in their winter plumage on arriving, the black throat and breast being seen only exceptionally.

Beatle-heads have never been numerous or in large flocks; usually isolated individuals are scattered over the sandy edges of the salt marshes, and occasionally flocks of six to ten are seen.

Their plaintive cry is heard throughout the season, and they remain longer than any of the shore birds, often being found in considerable numbers, I am told, till October 15th. In their plumage they are generally in a transition stage from the summer to the winter coat, specimens with the black breast and belly being quite common, although not in the majority.

Wilson's snipe is a rare visitor. Nearly every year one or two are seen on the freshwater brooks, but the country is not adapted to their habits, and no conclusions can be drawn from their absence.

Of the ducks, by far the most common, as would be expected, are the dusky and marsh ducks. The country with its numerous small ponds and dense thickets of bushes is particularly adapted to their breeding habits; and twenty-five years ago when "the moss" was practically undisturbed by visitors during the summer, they bred in large numbers, and on my arrival I always found many broods of half-grown birds in the ponds, which became able to fly only in September. Now "the moss" is much more frequented in the summer than formerly, and the number of breeding birds is much less. Large numbers of migratory birds, however, make the island a stopping place, arriving in large numbers from the 10th to the 25th of September. By the 7th of October, I am told, they have usually all left. Most of them have the olive-green leg and foot, and the majority are birds of that season, *i. e.* young, but the large variety with the orange-red leg and foot, the so-called Hudson Bay duck, is not uncommon late in September, and I have never been able to see any difference in their habitat. The two varieties fly together. Breeding in confinement has, I believe, proved that the orange-red variety is only an older bird. They feed almost entirely on the seeds of the eel-grass (Zostera marina).

Some five years ago I obtained an adult drake mallard that was flying with a small flock of dusky ducks. It is the only specimen I have ever seen on the island, and as it was wholly unknown to the local gunner, it must be a very rare visitant.

The blue-and-green-winged teal vary very much in numbers in different years, but on the whole are much less numerous than in the seventies. I have rarely found them on the island on my

arrival, but they arrive during the first two weeks in September, the blue-winged always being much more numerous than the green-winged. It is a curious fact that I have never seen a specimen either of the teals, pintails or whistlers, which showed the head-plumage characteristic of the adult male. That there should not have been an adult male in all these years is most unlikely, and the explanation must be, I think, that the birds had not fully recovered their full plumage after moulting. We have yet much to learn of the changes in the plumage of birds.

Pintails rarely make their appearance before the 15th of September, arriving with or a little after the northern dusky ducks, and flying sometimes in flocks by themselves, but often mingled with the dusky ducks. By the end of September or early in October, they have disappeared. I have never known them to breed on the island, and have never seen one in August.

Whistlers are the latest of all the ducks to arrive, usually about the 20th of September, and they occasionally appear in large flocks. I have never known them to breed on the island, but formerly, I am told, they did so, and the resident gunners are familiar with the fact that they nest in trees and call them "wood-ducks."

The story of the geese on Miscou, as I have received it from Mr. Charles Wilson, one of the oldest residents, is rather interesting. Eighty or more years ago, geese bred upon "the moss" in large numbers, and it was the custom of the Micmac Indians to visit the island during the moulting season and destroy large numbers of them with clubs when they were unable to fly. After one such raid, more determined than usual, the geese as a body abandoned the island for a breeding ground, and since then only an odd pair have now and then raised a "clutch" here. I have seen a few such clutches, and some ten years ago found several of the broken eggs in the northwest corner of "the moss" The arrival of the geese from the north is very uncertain. I have found as many as one hundred and fifty on the island in August, and in other years not a goose is seen before September 10th, from which date they are continually seen making the island from the sea and gather in constantly increasing numbers to remain

till frozen out. The main body of their flight is, I think, decidedly later than it used to be, but the time varies in different years, and the numbers are sadly diminished from what they were in the seventies. The clutches of young geese are particularly fond of "the moss," and after their arrival often entice the whole body of birds to same distant spot on "the moss," where they remain for hours. Years ago the daily flight of the geese when undisturbed was very regular. They fed in the two Malbaies on the roots of the eel-grass through the night till the tide was about half-flood, when they would fly to the Big Lake to drink, and from thence to Little Shippegan Harbor where the day was spent, to return to the Big Lake again at about half-flood tide, and thence again to the Malbaies. Of late years the tides seem to have much less influence, and the evening flight is postponed till dusk or even later. When the birds are numerous, the shores of the Malbaies are lined with floating eel-grass, every root of which has been nipped off.

Brant are such a late arrival that they hardly come into the season I speak of. An occasional flock comes in from the north in September, and the earliest date at which I have seen them is September 18th. In late October they are abundant.

All varieties of birds are much less numerous then formerly, while some have almost abandoned the ground. Changes in the local surroundings will account for part of this loss. "The moss" is much more disturbed by travellers, the number of gunners has increased many fold, and the gunning is indiscriminate and injudicious; extensive fires and the resulting blueberries are much less common than formerly. All of these factors are, I think, of importance, but in addition I am confident there has been a change in the course of the flight of some varieties. This is especially true of the golden plover, for I hear of large flights of these on Prince Edward Island when there have been none on Miscou, where twenty-five years ago we should have had the same flight.

ARTICLE IV.

# OBSERVATIONS ON WEATHER AND PLANTS, 1906.

BY G. U. HAY.

*May* 1.—An unusually mild winter was followed by cold backward weather through March and April. January and February were almost without snow in St. John, and the surrounding country. The last part of January, and nearly all of February were generally mild and warm, with occasional cold snaps. On Friday, February 2nd, a party of newspaper men chartered a tug and went to Carter's Point on the St. John River, fifteen miles from the city, where the first ice was met with. During the severe frost of the few following days the greater part of the lower end of the river was frozen over.

The St. John River was not open to navigation until the 18th April.

Coltsfoot (Tussilago farfara) was found in bloom in Rockwood Park, April 28th. It has been found blooming near St. John as early as the 28th March.

## WILD GARDEN, INGLESIDE.

*May* 15.—All through April and the first half of May, cold rainstorms prevailed with occasional warm days. The sun's rays penetrated but slowly into the earth where the frost had gone unusually deep, owing to cold snaps and absence of snow. This kept farming operations back.

Alder and poplar catkins were observed discharging pollen April 21st. The fields at this date were unusually brown and bare, with a little snow and ice in the woods. May 5th—Red maple, leather-wood (Dirca palustris), white hepaticas, and a few white violets (Viola blanda) in bloom. On May 7th—a cold and heavy rain of twenty-four hours' duration was followed by a spring-like afternoon, so balmy and rare in this inclement season that it gladdened everything having life, but wintry rains and repressing chills followed. May 9th—A few fawn lilies (Adder's tongue), strawberry blossoms, white violets, mayflowers, the latter in full bloom in open woods and quickly dropping their

petals, but still in bud in deep shades. Frost for several nights during the past week. This morning (May 15th) the thermometer registered 37°F at seven o'clock, followed by a bright warm day.

*May* 18.—During the past three days the weather has been warm, and dry. Farming operations were begun and carried briskly forward; buds are rapidly unfolding and the whole face of nature has undergone a surprising change within a few days.

The white petals of the hepatica are nearly all fallen. Blue violets and strawberry plants in full bloom. A few dandelions have opened in sunny places, and one or two amelanchier trees are almost in flower, a few white trilliums (Trillium grandiflorum) brought from Ottawa, and planted in the spring of 1905, are opening into flowers, while others near by, brought from the same place and planted ten years ago, still keep their buds obstinately closed, opening ten or twelve days later. (The spring is a fortnight earlier usually at Ottawa than about St. John).

*May* 20.—The genial sunshine of the past four days with a strong north wind today has shaken innumerable buds into leaf and flower. Sanguinaria, uvularia, houstonias, amelanchiers, painted trilliums, gold-thread are rapidly coming into bloom, while the blossoms of the fly-honeysuckle (Lonicera ciliata), the wind-flower (Anemone nemorosa), fawn lily, the long pendulous tassels of the mountain alder, the flowery involucre of viburnum lantanoides and the white trilliums are fully expanded.

In ferns, the fronds of osmundas and the ostrich fern are from three to twelve inches in height, while the woodsias on the rockeries and the phegopteris in the meadows, are fully unfolded. The elder (Sambucus pubens), pyrus, carpinus, trembling popular and small birches and alders have their leaves fully unfolded. The larger birches, amelanchiers, black and red cherry, maples are moving rapidly from bud to leaf. The flowers of the red maple have been falling for several days in the open, but they still redden the deeper woods where there is an indefinable mingling of red and brown and green "and nothing perfect."

*June* 1.—Nights very chilly, with frosts, on May 31st and June 1st. Easterly and northeasterly winds have prevailed with cold rains for a week past. In flower everywhere—purple

trillium, painted trillium, bluets, bell flower, dandelion, marsh marigold, white baneberry, wild red cherry, with a few plants of rhodora and nodding trillium opening. Petals of amelanchier are falling. Owing to continued cold and wet weather many early flowers, such as the white trillium, wood anemone, mayflower and others still preserve their beautiful bloom. For the same reason the leaves of the great-tooth-leaved poplar, white or swamp maple, red oak, white ash, acacia, sumac and other late forms are just expanding into leaves; but nearly all other deciduous trees are now in full foliage.

*June* 4.—Transplanted acacia, flowering raspberry, sumac and other shrubs, the damp weather being in favor of late planting. Flowers are appearing on pyrus baccata and its varieties, on the Siberian pea tree, purple clematis, blueberry plants and bunchberry (Cornus Canadensis).

*June* 11.—Stemless lady's-slipper, apple trees, lilacs, yellow lady's-slipper coming into bloom.

*June* 13.—The first really hot day of the season. Maidenhair fern fronds fully expanded. A little later the butterwort (Pinguicula vulgaris) is in bloom and other late flowers are opening, including the erigerons, forerunners of the asters and golden rods.

*October* 20.—A beautiful summer but very dry and hot; no rains of any consequence after June. The wells everywhere were dry. The river St. John which has been very low began rising this week from heavy rains in the north. The warm weather has continued through the autumn. Occasional light frosts occurred after the middle of September, but not sufficient to kill vegetation. There were more severe frosts on the nights of the 12th, 16th, and 17th, when a very thin surface of ice was formed on pails of water standing out, barely sufficient to notice. The fine weather has continued through September until late October, but the woods have not had so bright a coloring as in other years. The deciduous leaves are dry and shrivelled with a few notable exceptions such as the brilliant red of the ironwood and the dark red of the oak. Several trees and shrubs, such as the black cherry and lilacs, still retain their summer green (October 20).

The autumn was characterized by a great dearth of the larger fungi, owing to the excessive dryness.

"The Constitution of the Interior of the Earth as revealed by Earthquakes" is the title of an important paper by R. D. Oldham, F. G. S., presented to the Geological Society of London, February, 1906. As the spectroscope extended the scope of astronomical knowledge by enabling the astronomer to determine the composition of the heavenly bodies, so the seismograph enables the physicist to determine the constitution of the earth at depths removed from any other possible means of research.

The distant record of a great earthquake exhibits three distinct phases, of which the third represents wave-motion which has travelled along the surface of the earth, and gave no information regarding the earth's interior. The other two phases form the preliminary tremors, and it is shown that they represent the emergence of two distinct forms of wave motion which have been propagated through the earth.

A study of the intervals taken by these waves to reach remote points shows, that up to a distance of 120° of arc from the origin they are propagated at a rate which increases with the depth of the wave-path. The increase being gradual and continuous, may be attributed to the effects of increased pressure and temperature, and there is no indication of any change in physical constitution of the material traversed by waves which merge at 120° or less from the origin.

Beyond this limit the first-phase waves show a reduction in the mean rate of transmission, while the second-phase waves are not to be found where they would be expected, but about 11′ later. The interpretation is that the wave-paths emerging at these greater distances have entered a *central core* in which the rate of transmission of the first-phase waves is reduced to about nine-tenths, and the second-phase waves to about one-half of the rate in the outer shell.

The conclusion reached is that after the outermost crust of the earth is passed, there is no indication of any rapid or material change of physical condition (nor probably of chemical composition) *until* a depth of about *six-tenths* of the *radius* is reached; but that below this there is a rapid passage to matter which has very different physical properties, if not also differing in chemical constitution. It will be seen that this central core is but a small fraction of the mass of the earth.

# REPORT OF COMMITTEE ON BOTANY.

The committee would again urge the attention of the Society to the importance of preparing a new list of plants for the province. The preparation of such a list has been under consideration for several years past, but owing to the delay in issuing the new edition of Gray's Manual, the work has not been undertaken. There has been considerable confusion in recent years in the Northeastern United States and Canada in regard to botanical nomenclature, and the making of distinct species out of those that have been hitherto regarded only as varieties or forms. The appearance of the new edition of Gray's Manual will, it is hoped, authoritatively settle many disputed points about the naming of plants and the confusion arising from sub-division of species. In such circumstances it is wiser to wait; and the waiting time may be used to good advantage if all students interested in the plants of New Brunswick will investigate during the coming season and send reports (accompanied by specimens) of any new species found, or the distribution of those plants described as rare in the lists that have appeared from time to time in the Bulletins of the Society. In collecting plants, students should be careful to give notes of the exact situations in which they are found, such as soil conditions and association with other plants—in a few words, to give as accurate a picture as possible of the surroundings and conditions of each plant. We are in need of more information concerning the distribution of weeds and the introduction of new forms as they may appear; to make observations of our forest trees and their conditions of growth, and what trees are becoming rare, and the cause; to collect all the facts about the local uses of plants and their local names.

The range and distribution of our flowering plants and ferns have not been very carefully studied, except in a few separated districts. The greater part of the province remains yet to be visited by plant students and reported upon.

It is desirable to incorporate in the new list as accurate a knowledge as we possess of the so-called Flowerless Plants. Some groups of these have not been studied and listed, such as our fresh-water algæ and our parasitic fungi which do so much damage to the higher forms of vegetable life. Other groups, as the marine algæ, larger fungi (mushrooms, toadstools), mosses and lichens have been partially listed in our Bulletins. Much work still remains to be done among these groups in order to present anything like an adequate list of the species to be met with and their distribution in this province.

## NEW AND RARE PLANTS.

A note from Professor Ganong reports *Nymphaea odorata* abundant in ponds on the barrens of Miscou—farther north in New Brunswick than hitherto reported.

Mr. William Crawford, of Millerton, N. B., reports finding *Sagittaria subulata,* which, on the authority of Dr. Fletcher, of Ottawa, is its first reported appearance in Canada. Mr. Crawford also reports *Limosella aquatica,* a rare plant in this province.

The following plants, reported by Professor Ganong from Miscou, are probably new to New Brunswick:

**Achillea lanulosa,** Nutt. A western form.

**Viola adunca,** J. E. Smith. A western form.

**Rosa acicularis,** Lindl. The same as *R. Engelmanni* and *R. Sayi* (now considered as one species) of Gray's Manua 6th Edition.

G. U. HAY,
*Chairman Botanical Committee.*

# APPENDIX.

## FORTY-FIFTH ANNUAL REPORT

OF THE

## COUNCIL OF THE NATURAL HISTORY SOCIETY

OF

## NEW BRUNSWICK.

The Council of the Natural History Society of New Brunswick beg leave to submit the following as a summary of the work done by the Society during the year ending December 31st, 1906.

### MEMBERSHIP.

During the year the membership has been increased by the admission of twelve ordinary, fifty-two associate and one junior member, making a total of 256.

The following shows the numbers, classes and total enrolled membership:

| | |
|---|---|
| Honorary, | 8 |
| Life, | 9 |
| Corresponding, | 24 |
| Ordinary, | 66 |
| Associate, | 145 |
| Junior, | 4 |
| Total, | 256 |

### TREASURER'S REPORT.

*Expenditure—*

| | |
|---|---|
| Legal Expenses re purchase of New Building. | 75 00 |
| Maintenance of Museum, | 99 35 |
| Library, books and binding, | 9 89 |
| Printing and distributing Bulletin XXXIII, | 234 75 |

| | | |
|---|---|---|
| Payments on New Building, | 7,104 92 | |
| Sundries, removing collections, altering building,.. | 192 81 | |
| Water rates, | 23 50 | |
| Six months interest on mortgages, | 97 50 | |
| Sundries, | 358 38 | |
| Balance Bank of New Brunswick, | 482 51 | |
| | | $8,678 61 |

Examined and found correct, 9th January, 1907.

JAMES J. ESTEY,
J. ROY CAMPBELL,
*Auditors.*

*Income—*

| | |
|---|---|
| Balance from 1904-5, | $252 94 |
| Interest on investments, | 99 62 |
| Bulletins sold, | 3 00 |
| N. B. Government Grant, | 200 00 |
| Membership fees, | 259 00 |
| Dividend Botsford Estate, | 10 00 |
| J. Roy Campbell (services, donated) | 75 00 |

*Donations—*

| | | |
|---|---|---|
| Mrs. Gilbert Murdock, | $100 00 | |
| Dr. Geo. F. Matthew, | 100 00 | |
| Miss C. R, Fullerton, | 1 00 | |
| Hon. John V. Ellis, | 100 00 | |
| "A Lady member," | 5 00 | |
| T. H. Estabrooks, | 100 00 | |
| Byron E. Walker (Toronto, Ont.) | 25 00 | |
| John O'Regan, | 25 00 | |
| Emmerson & Fisher, | 25 00 | |
| Manchester, Robertson, Allison, Ltd., | 100 00 | |
| Prof. W. F. Ganong (Northampton, Mass.) | 100 00 | |
| John Moser, | 1 00 | |
| Comeau & Sheehan, | 25 00 | |
| R. Keltie Jones, | 10 00 | |
| Rev. Prof. J. Fowler (Kingston, Ont.) | 5 00 | |
| W. Cushing (Pittsburg, Penn.) | 10 00 | |
| | | $732 00 |

| | |
|---|---|
| Hazelhurst mortgage sold, | 1,500 00 |
| Cheyne mortgage sold, | 900 00 |
| Special Deposit Bank of Nova Scotia interest withdrawn, | 103 72 |
| Rents, | 33 00 |
| Proceeds High Tea, | 323 62 |
| Received from Ladies' Association, | 150 00 |
| "Building Fund," Bank of Montreal, withdrawn | 12 71 |
| Received from Fredericton Society, | 24 00 |
| Raised on mortgage to McDonald, | 2,000 00 |
| Raised on mortgage to Dr. G. U. Hay, | 2,000 00 |
| | $8,678 61 |

Of the above balance, $33.00 is held in trust for the Ladies' Association, and $40.00 for botanical work, as set forth in the report for 1903.

It will be noticed by referring to the above statement that the year has witnessed the heaviest financial transactions in the history of the Society.

That the efforts of the Society to provide a Museum of inestimable value as an aid to education has been appreciated, is shown by the generous contributions already received, and there is little doubt but that the sum received up to the time of the closing of this report will be but a small fraction of what will be placed at the Society's disposal in the future.

Our only liabilities consist of two mortgages of $2,000.00 each, but, until these are both disposed of, the members should exert every effort, for the carrying of them will, to some extent at least, restrict the good work which it is the privilege of the Society to prosecute.

Our building is insured for $8,000.00, and the collections for $3,500.00.

A. Gordon Leavitt,
*Treasurer.*

## Library.

The housing of our Society in its new building has provided for our library more commodious and convenient quarters, and will enable us to place all our collection within easy reach of the members. The details of re-arranging the library in our new rooms has been looked after by the Assistant Librarian, Miss Hoyt, and I am indebted to her for much valuable assistance in the work in hand. The library has been increased during the past year by the addition of the transactions and other valuable publications of many of the scientific societies at home and abroad.

W. Leonard Ellis, *Librarian.*

## Lectures.

Ten regular meetings, including the annual meeting, and three special meetings, were held during the year.

The following are the dates of the meetings and the titles of the papers read:

January 2.—(a) Shooting Stars and Meteors, by Mr. W. F. Burditt.
(b) The Physiography of the North Branch of the Little Southwest Miramichi, by Dr. W. F. Ganong.
(*c*) On the Recognition and Utilization of the Plateau structure of the interior of New Brunswick, by Dr. W. F. Ganong.
January 16.—Annual meeting, Election of Officers.
February 6.—(a) Why is the Winter so Mild, by Dr. G. F. Matthew.
(b) Cellular Structure, with Miscroscopic Demonstrations, by G. G. Melvin.
(*c*) On the Physical Characteristics of the Sevogle River, by Dr. W. F. Ganong.
(d) Among the Game Birds of Miscou Island, by Mr. J Orne Green.
March 6.—(a) On a Curious Disease Prevalent at Passamaquoddy in 1796, by Dr. W. F. Ganong.
(*b*) Notes on Cambrian Faunas, by Dr. G .F. Matthew.
(b) Notes an Cambrian Fauna, by Dr. G. F. Matthew.
(c) Tides, by J. R. Scammell, C. E.
(d) The X-Ray, with Illustrations, by Dr. G. G. Corbett.
April 3.—(a) Dark Lake and its Denizens, by Mr. J. W. Banks.
(b) The Industries of Animals, by Dr. T. H. Lunney.
(*c*) Natural Curiosities said to occur in New Brunswick, by W. F. Ganong.
May 1.—(a) The Physical Geography and Natural History of the North Shore Beaches, by Dr. W. F. Ganong.
(b) Plant Relations, by Dr. G. U. Hay.
(c) Plant Functions, by Dr. John Brittain.
May 15.—Special meeting for the purpose of receiving a report from the Council, with reference to the acquisition of a property.
June 5.—(a) Preventive Medicine, by Dr. J. H. Scammell.
(b) The Natural History and Physiography of New Brunswick, by W. F. Ganong.
(c) Report of Delegates to the Royal Society, Hon. J. V. Ellis.
October 2.—Results of the season's Field Meetings, Dr. G. F. Matthew, Mr. A. Gordon Leavitt, Mr. William McIntosh.
November 6.—An evening with the Reflectoscope, Dr. L. W. Bailey and G. N. Babbitt.

December 4.—(a) The Central Plateau of New Brunswick, by Dr. W. F. Ganong.
(*b*) The square Forks of the Sevogle River, by Dr. W. F. Ganong.
(c) Notes on Archaeozoon, by Dr. G. F. Matthew.

December 17.—Insects, What they do and Where they are Found, by Dr. James Fletcher.

## ELEMENTARY LECTURES.

The usual Elementary Talks on Plant and Animal Life were given on Tuesday evenings, not occupied by regular meetings of the Society, during the months of January, February and March. These lectures were not only for members, but for every one interested in the natural history of the province.

The following were the dates and titles of the papers read:

January 23 and 30.—Life on the Seashore, by Mr. Wm. McIntosh.

February 13 and 20.—Comparative Zoology, Bird Life, illustrated by Mr. A. Gordon Leavitt.

February 28 and March 13.—Fishes, Batrachians and Reptiles, by Mr. C. F. B. Rowe.

March 20 and 27.—Simple Talks on Plant Life, by Dr. G. U. Hay.

## ORNITHOLOGY.

The numbers refer to the list of birds printed in Bulletin No. I, 1883.

Species which occur in St. John and Kings counties:

6.—Bluebird (Sialia sialis).

NOTE.—I reported a female in Bulletin XVI, and have now pleasure in stating that five specimens of this beautiful and much admired and honored bird, were observed at Nerepis on October 13th, by Wm. McIntosh.

23.—Chestnut-Sided Warbler (Dendroica Pennsylvanica) given as "a rare summer resident."

NOTE.—I observed a beautiful specimen of this species at Nerepis on May 27th.

SECTION B.—Species which have not been observed in St. John and Kings counties, but which occur in other parts of the province:

247½.—(This number to bring species in proper position on list).
—Whistling Swan (Olar Columbianus).

NOTE.—This species was not recorded by Chamberlain in list in Bulletin I, but on page 40 of Bulletin II appears this note: "The only example of this species known to have been observed in this Province, was shot by Geo. Barnhill, Esq., at Belvidere Lake, on April 8th, (1882).

On December 15th, a specimen of this species arrived from Grand Manan, where it had been shot. It was purchased by a Mr. Medford, who had it skinned by a local taxidermist, and later presnted it to our Society. Although both as a bird and a skin it had received unusually hard usage and handling, it was considered too valuable a specimen to be thrown away, and was therefore mounted by the writer, and will be added to the Society's collection as soon as it is properly seasoned.

ADDITIONAL NOTES.— The English Sparrow (Passer domesticus) is now far too abundant, and its great numbers may be accounted for by the number of broods reared, as will be noted from the following: On April 2nd I picked up a dead young bird evidently a couple of days old, and on September 10th I observed a female feeding young.

It is only necessary to add to this report that the entire collection of birds has been removed to our new quarters where will be found 320 specimens, embracing 192 species, labelled and arranged according to the classification of the American Ornithological Union.

The work of moving this collection was necessarily slow and required much care and it is a great pleasure to be able to state that but one specimen was seriously injured in transit. Quite a number of duplicates have been placed in the store room.

Respectfully submitted,

A. GORDON LEAVITT.

## REPORT OF ZOOLOGY.

Your Committee on Invertebrate Zoology beg to submit the following report:

During the past year collecting has been carried on by A. Gordon Leavitt, William McIntosh and others. Particular

attention being paid to land and freshwater shells and insects. The shells are at present in the hands of specialists for identification, and when returned will be placed in the Museum.

A large number of insects have been taken, some of which are of great interest. Mr. Leavitt captured two very rare moths. The first, "The Gaudy Sphinx," Argeus labruscæ. a native of South America and Florida, is extremely rare in Canada.

The second, the Brown Tail Moth, we hope will remain rare. This is the second specimen of this very destructive species taken in Canada, the first was captured by the writer about four years ago. This Moth has been reported from Nova Scotia and other parts of the Dominion. But Dr. Fletcher states that the St. John records are the only authentic ones, the others being moths which were mistaken for the "Brown Tail."

The writer was fortunate in capturing a beautiful specimen of the Red Barred Sulphur Butterfly, (Callidryas philea). This magnificent insect is found in South America and the Southern States, this being the first record of its occurrence in Canada. Other rare species have been taken but they are of less interest than those mentioned above.

We are pleased to report that the invertebrate collections sustained no damage in their removal from the market building. They have been placed in the room assigned to this branch. Lack of time did not permit a careful arrangement before the public opening of the Museum, and much remains to be done to make this department of permanent interest to visitors, and of educational value to the young.

WILLIAM MCINTOSH,
*Chairman.*

## REPORT COMMITTEE ON BOTANY.

No additions to the list of New Brunswick Plants have been made since the publication of the Bulletin of 1905. Since that time several discoveries of plants new to the province have been made, not only by our local botanists, but by others interested in our flora. Professor Ganong and Mr. M. L. Fernald of Cambridge, Mass., have made some important additions to our knowledge of plants which will be found on the pages of this year's Bulletin.

In the summer and autumn of 1905, several additions were made to the mycological plants or fungi of the province. The past season was so dry all over this province that the fungi did not come forth in the usual abundance, so that few collections were made.

The committee realize more fully that a new and revised edition of our flora should be published at an early date. Such a revision can be made with better advantage after the publication of Gray's New Manual, for which the committee is waiting.

G. U. HAY,
*Chairman Committee on Botany.*

## FIELD MEETING.

Three field meetings were held during the summer of 1906. The first was at Gondola Point on the Kennebecasis.

The morning threatened rain but a goodly number of members assembled at the steamer Clifton which was to convey the party to their destination. The passage through the narrows gave excellent opportunity for observing the contrast of the Huronian Limestones, with the beds set up on edge and cut by dykes of dark colored trap, and the horizontal red sandstones that rest upon them and border the shores toward the Boar's Head.

Passing around Boar's Head the steamer opened up the wide reach of the Kennebecasis River, dotted on the south side by the limestone islands of Ragged Point and the Brothers, and skirted on the north by Kennebecasis Island and the low granitic cliffs of Barlow's Bluff. In passing up through Kennebecasis Bay, one of the members of the party gave an impromptu lecture on the chequered geological history of the Kennebecasis valley, showing the various geological forces which in the past had moulded its outlines; this history goes back to pre-Cambrian times.

In the upper part of Kennebecasis Bay a fine opportunity is had to observe the contrasted contour, presented by the old volcanic rocks of the north shore of the river, and the worn sedimentary deposits of the south side—the former showing in

bold cliffs and abrupt hills, the latter exhibiting rounded and gently sloping eminences, with deeply indented coves at intervals along this shore.

The excursion landed at Flewelling's Wharf, near Gondola Point, from which exploring parties went down the road and along the shore in search of the wild flowers that were then in full bloom, and other objects of interest to the naturalist.

A lunch was served on the piazza of Dr. Matthew's summer cottage, and afterward parties were organized to explore up the road and along the shore as far as Gondola Point. Some interesting examples of ripple marks and faults were observed in the red sandstone ledges along the shore, and observations made on the conglomerate ledges that come out on the river above Gondola Point.

The parties then went back to Flewelling's Wharf to await the return of the steamer Clifton which soon appeared and bore the party back to Indiantown, after spending a very pleasant day.

The second field day was held at "Camp Nature',, the summer observing centre of Messrs. McIntosh and Leavitt.

For this meeting the weather was more propitious than on the former occasion, and the attendance larger. To reach Camp Nature the party had to use the C. P. R. train, which deposited them at a siding a short way above Nerepis station; thence a pleasant walk along the track, along the highway and by a path through the woods brought the party to a delightful little bark covered cabin embowered in trees, and tastefully decorated for the occasion. Rustic seats under the trees provided ample accommodation for the visitors, and here an acceptable lunch was spread for all who chose to partake. After lunch an excursion was organized to visit the gravel plain near by, that border the west side of the Nerepis river, and some fossiliferous ledges of Silurian rocks which Messrs. Leavitt and McIntosh had discovered at the back of this plain.

On the return of the parties to headquarters some interesting addresses were given by the leaders on the geology of the neighborhood and on the trees observed in the vicinity of the camp. On the return, while waiting for the train that was to bear the party back to town, the growing darkness was taken advan-

tage of by another leader to call attention to the constellations in sight in the heavens, and to explain the composition and the motions of some of the heavenly bodies.

The third field meeting was held at Crouchville on Courtney Bay, east of St. John.

From Mr. Burditt's house (who was host on this occasion), excursions were made in several directions. The principal one was along the shore of Courtney Bay, where the low cliffs of slate and flag stones of the St. John Group, worn by the sea, afford excellent examples of folding and faulting in stratified rocks, the surfaces of these flags exhibit good examples also of the burrows and trails of marine animals, which may be compared with those in the recent sands of the flats which mantle around these slaty ledges.

After the lunch which was served on the lawn in front of Mr. Burditt's house, Messrs. McIntosh and Leavitt gave short addresses on the seas shells and the sea birds respectively, and as the darkness was now on, there was opportunity for some remarks on the stars by Mr. Burditt. The party returned to town after a very pleasant and instructive afternoon's excursion.

## General.

An event of far reaching importance to the Society was the purchase in June last of the Finn Building on Union street. Occupying a central and convenient position, strongly built of stone and brick, and with ample accommodations for the growing necessities of our Society, this building provides the "Home" that we have been looking forward to for years. Its fine halls and rooms, comfortable, commodious, well lighted, are admirably fitted for the advantageous display of the treasures of our Museum, and of making these the objects of a great and permanent interest to the citizens of St. John and the people of New Brunswick.

No sooner was the purchase accomplished than willing hands among our members set to work to remove the Museum and Library to the new building; and the close of the year witnessed the Society comfortably installed in its present quarters with fresh

hope and confidence in the accomplishment that should be ours in the years to come.

The citizens of St. John have shown their appreciation of our efforts in no uncertain way. Our membership has already been largely increased, and generous donations have been contributed towards removing the debt incurred by the purchase of the building.

Among the improvements made are two that were specially desirable,—the removal of a central room and walls on the second floor, east side, making a continuous room, running the whole length of the building from north to south; and the removal of the arches and folding doors from the parlors on the first floor. By the latter change the Society has secured a fine audience room capable of seating 300 persons, and by the former a large and commodious room has been made available for the display of the birds, reptiles, fishes, minerals and fossils.

Other changes are in contemplation that will make other parts of the building more suitable for our purposes.

W. L. McDiarmid,
*Secretary.*

# ANNUAL REPORT OF THE LADIES ASSOCIATION OF THE NATURAL HISTORY SOCIETY.

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The Ladies Association of the Natural History Society beg to report a very successful year's work. The usual course of free lectures was given last winter, and was well attended in spite of some very stormy weather.

In the spring the ladies gave a very successful High Tea, and rendered valuable assistance with the Loan Exhibit, held at the same time at the York Theatre. About $350 was realized at this entertainment, which was considered one of the most attractive affairs of the kind ever held in St. John, and the money put by for the building fund of the Society. Later in the spring it came in very usefully towards the purchase of our present building.

In the fall a series of Reminiscent Talks was given by ladies of the Society and their friends, and from a course of nine talks and two extra ones, they realized $190. Of this sum $150 was paid to the treasurer of the Society to enable us to have a Librarian who will keep the Museum open to the public every day except Sunday, from two to six p. m.; $40 still remains in the bank to be used as may seem best. Some of the ladies suggested that it might be given towards the purchase of a Reflectoscope.

The ladies furnished refreshments for the opening reception at the Museum, and have also envited the pupils of Netherwood School and of the Rothesay College for Boys, to an informal lecture and reception at the Museum some time during this month.

The usual course of free afternoon lectures has been arranged for the winter months, with special reference to the High School.

We have had an increase of over fifty percent in our membership, during the past few months, and in every way we feel we are at the close of a very successful year, and we hope at the beginning of one more so.

The vast opportunities for progress offered by our new building for the Ladies Association as well as for the parent Society, fills us with hope and courage.

Respectfully submitted,

K. M. MATTHEWS,
*President Ladies' Association.*

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## DONATIONS TO THE MUSEUM, 1906.

| DATE | DONOR'S NAME AND DESCRIPTION OF GIFTS. |
|---|---|
| January... | Principal W. L. McLean, Petrified Wood, from Saskatchewan R.; also Buffalo Teeth. |
| February.. | Captain Beverly R. Armstrong, a Bird's Nest. |
| | Mr. W. L. Dobbin, Sponge, with small shell attached, Quaco Ledge. |
| April...... | Miss Cameron, Blue Heron; also Indian Implements, from Ontario. |
| | Mrs. J. R McIntosh, Fossil Wood; also Conch Shell. |
| | Mrs. James Whitney, a specimen of Coral. |
| June . .... | Capt. R. C. Cole, Cryolite, from Arksutfjord, Greenland. |
| October.... | Mr. Charles Wilson, a Walrus Tusk from Miscou Island. |
| | Mr. J. A. Estey, Rocks and Minerals (Asbestos, etc.), from Westfield. |
| December. | Mr. C. W. Grant, skin of Boa Constrictor. |
| | Mrs. William Kerr, a large Beetle. |
| | Mr. William Finley, weathered Granite Boulder, found at Westfield. |
| | Mr. A. G. Leavitt, a carved Ballot Box. |

# DONATIONS TO THE LIBRARY, 1906.

| *Donor's Name.* | *Residence.* | *Works.* |
|---|---|---|
| Academy of Natural Science | Philadelphia | Proceedings |
| Academie Imperial des Sciences | St. Petersburg | Bulletins |
| Acadia College Library | Wolfville, N. S. | ........ |
| American Museum of Natural History | New York City | Bulletins |
| Australian Museum | Sydney, N.S.W | Reports |
| Amherst College | Amherst, Mass | Year Book |
| Academy of Science | St. Louis, Mo | Bulletins |
| Archæological Society of Ontario | Toronto | Report |
| Academia de Ciencias Y Artes | Barcelona, Spain | Bulletins |
| Belfast Naturalists' Field Club | Belfast, Ireland | Report |
| Boston Free Public Library | Boston | Reports, etc. |
| Boston Society of Natural History | Boston | Bulletins |
| British Museum of Natural History | London | Publications |
| Buffalo Society of Natural History | Buffalo, N.Y | Reports, etc. |
| Bureau of Ethnology | Washington | Bulletins |
| Bureau of Government Laboratories | Portland, Me | Reports |
| Botanical Gardens | New York City | Proceedings |
| Bureau of Plant Industries | Washington, D.C | Reports |
| Canadian Archives | Ottawa | Reports |
| California Academy of Sciences | San Francisco | Proceedings |
| Canadian Institute | Toronto | Bulletins |
| Cincinnati Society of Natural History | Cincinnati | Bulletins |
| Cincinnati Museum Association | Cincinnati | Reports |
| Colorado Scientific Society | Denver, Col | Proceedings |
| Canadian Entomologist | Guelph | Journal |
| California, University of | Berkley, Cal | Proc'dngs, etc. |
| Colorado College | Colorado Springs | Reports, etc. |
| Crown Lands Department | Fredericton | Report |
| Carnagie Institution of Washington | Washington, D.C | Bulletins, etc. |
| Canada Year Book | Ottawa | ..... |
| Census and Statistics Office | Ottawa | Report |
| Comite Geologique | St. Petersburg | Bulletins, etc. |
| Connecticut Society of Science and Arts | New Haven | Proceedings |
| Cornell University | Ithaca, N.Y | Reports, etc. |
| Davenport Academy of Sciences | Davenport | Bulletins |
| Department of Inland Revenue | Ottawa | Bulletins |
| Department of Indian Affairs | Ottawa | Report |
| Dalhousie College | Halifax | Report |
| Department of Agriculture | Ottawa | Reports, etc. |
| Department of Mines | Nova Scotia | Report |
| Education Office | Fredericton | Report |
| Ethnological Survey | Manila | Proceedings |
| Educational Review | St. John, N.B | Journal |
| Feuille des Jeunes Naturalistes | Rennes | Journal |
| Field Columbian Museum | Chicago | Bulletin |
| Field Naturalists Club | Ottawa | Journal |
| Geography, Journal of | Syracuse, N.Y | Monthly |
| Geological Society | London, Eng | Bulletins |
| Geological Society | Liverpool, Eng | Report |
| Geographical Journal | London | Journal |
| Geological Survey | Ottawa | Report |
| Gray Herbarium, Harvard | North Cambridge | Proceedings |
| Geography, School of | Lancaster, Pa | Journal |
| Geological Institute of Mexico | City of Mexico | Bulletin |
| Harvard Library | North Cambridge | Report |
| Iowa, Geological Survey of | Iowa | Report |
| Indiana Academy of Science | Indianapolis | Bulletin |
| Indiana Department of Geology | Indiana | Report |
| Johns Hopkins University | Baltimore, Md | Journal |
| Kansas Academy of Science | Topeka | Bulletin |
| Literary and Historical Society of Quebec | Quebec | Proceedings |
| Library of Parliament | Ottawa | Catalogues |

## DONATIONS TO THE LIBRARY, 1906—CONTINUED.

| *Donor's Name.* | *Residence.* | *Works.* |
|---|---|---|
| Library of Congress | Washington | Report |
| LinnæanSociety of New South Wales | Sydney, N.S.W | Bulletin |
| Liverpool Biological Society | Liverpool, Eng | Report |
| Lloyd's Museum | Cincinnati | Publications |
| Literary and Scientific Society | Ottawa | Report |
| Minister of Mines. West Australia | ...... | Report |
| Meteorological Office | Toronto | Bulletins |
| Missouri Bureau of Geology and Mines | Missouri | Report |
| Manchester Geological Society | Manchester, Eng | Proceedings |
| Minnesota Academy of Natural Science | ...... | ...... |
| Missouri Botanical Garden | St. Louis, Mo | Report |
| Maryland Geological Survey | ...... | ...... |
| New York State Museum | Albany, N.Y | Bulletins, etc. |
| Natural History Society | Glasgow | Report |
| Natural Science Association | New Brighton | Report |
| New York Academy of Science | New York | Bulletin |
| New York Public Library | New York City | Report |
| New York State Library | Albany, N.Y | Report |
| Nova Scotia Institute of Science | Halifax | Proceedings |
| New Zealand Institute of Science | Hobart Town | Bulletin |
| National Museum of Montevideo | Montevideo | Report |
| Natural Historichen N. of Museums | Wien | Bulletin |
| Ohio Naturalist | Columbus | Journal |
| Ohio, Geological Survey of | Columbus | Report |
| Public Museum of Milwaukee | Milwaukee | Bulletin |
| Peru Cuerpo de Ingenieros des Minas | Lima | Report |
| Philippine Journal of Science | Manila | Report |
| Queens Quarterly | ...... | ...... |
| Rochester Academy of Sciences | Rochester, N.Y | Report |
| Royal Academy of Science | Stockholm | Report |
| Royal Colonial Institute | London | Journal |
| Royal Society | London | Transactions |
| Royel Society of Canada | Ottawa | Proceedings |
| Royal Botanic Gardens | New England | Journal |
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| Smithsonian Institution | Washington, D.C | Reports, etc. |
| South Dakota School of Mines | Rapid City | Report |
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| U. S Commissioners of Agriculture | Washington, D.C | Publications |
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| U. S. Geological Survey | Washington, D C | Report, etc. |
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| U. S. National Herbarium | Washington, D.C | Bulletin |
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| Wisconsin Natural History Society | Milwaukee | Repert |
| Wilson Ornithological Association | ...... | Report |

# NOTES ON THE NEW BRUNSWICK WEATHER FOR YEAR 1906.

By D. Leavitt Hutchinson.

*January.*—The highest temperature recorded in New Brunswick 56° on the 23rd at Moncton, lowest 12° on the 3rd at Chatham. Unusually mild conditions prevailed throughout January. In all districts temperatures were much above the average. Near the bay shores of New Brunswick and in portions of the river counties the ground was, for the most part of the month, completely bare of snow. Spring-like weather was general, buds on trees swelling and river ice running. The most northern districts had sufficient snow for sleighing, but elsewhere bare ground was general. Much fine weather was recorded between the periods of precipitation, but the proportion of bright sunshine did not exceed the average.

*February.*—Highest temperature 49.5° on the 21st at Moncton, lowest 21° on the 17th at Sussex. High mean temperatures were again general, though minimum readings in some districts were somewhat lower than for the preceding month. There were several bright and almost springlike days, but much cloudiness prevailed, with frequent, though not very heavy, falls of snow or rain. Sleighing in the southern portions was fairly good between the 4th and 24th, but at no one time was there any large amount of snow on the ground. Southwest gales occurred on the 1st and 4th, and a heavy northeast to northwest gale, accompanied by a blinding snowstorm on the 28th.

*March.*—Highest temperature 55° on the 10th at Grand Manan, lowest 15.5° on the 6th at Chatham. In comparison with the two previous months, decidedly wintry conditions prevailed, the weather being cold and exceptionally windy. Four gales between 10th and 22nd had wind velocity from 36 to 48 miles an hour. That of the 20th was attended by drifting snow, and was the heaviest of the season. The good sleighing of this month was of great advantage to the lumbermen in the southern part of the province. At the close of the month the snow had

almost entirely disappeared in southern sections, but in the north from nine inches to a foot remained on the ground. Rivers and streams remained firmly frozen, and there was little indication of spring.

*April.*—Highest temperature 64° on the 30th at Chatham, and the lowest 5° on the 3rd at Sussex. Comparatively fine and cool, with precipitation above the average and much in excess of same month last year. From the 2nd to the 9th and 17th to 21st there was much fine weather, but the proportion of bright sunshine was much below the average. Vegetation was backward in all districts, with a late opening of rivers and streams.

*May.*—Highest temperature 81.5° on the 19th at Chatham, and the lowest 26° on the 11th at St. Stephen. The weather was cool and dull, with heavy falls of rain, which occurred on the 4th, 6th to 8th, 10th, 14th, 18th and 27th to 31st, making the aggregate amount considerably above the average. Fine weather was general during the intervening period, and the proportion of bright sunshine slightly exceeded the average. An inch of snow fell at McAdam on the 29th. Light frosts occurred frequently, and temperatures inland were well below freezing on the 12th. Vegetation was somewhat backward at close of the month.

*June.*—Highest temperature 90° on the 22nd at Dalhousie, and the lowest 32° on the 15th at Moncton. Unsettled, wet and cold weather prevailed until the 10th. Frosts were general on the 12th; heavy rain locally on the 24th. The remainder of the month was fine and pleasant, with seasonable temperatures. The mean proportion of bright sunshine exceeded the average. A severe thunder storm passed over Carleton and adjoining counties on the 27th, causing much damage, especially to young crops. Vegetation backward at close of month.

*July.*—The highest temperature was 91.5° on the 15th at Chatham, and the lowest 36° on the 26th at Sussex. The weather was, in general, fine, very warm and comparatively dry. Near the Bay of Fundy fogs prevailed on ten days, otherwise it was mostly bright and quite warm. A severe thunder storm on the 13th at St. John caused some loss of life and considerable damage to property. Vegetation was slightly below the average condition on the 31st.

*August.*—Highest temperature 100° on the 20th at Chatham,

and the lowest 35° on the 20th at Sussex. Hot and dry almost throughout the month. Forest and bush fires were most destructive in many localities, intensifying the exceptional and continued heat. Owing to drought in many districts, streams disappeared and vegetation was parched.

*September.*—Highest temperature 82° on the 12th at Chatham, and the lowest 25° on the 25th at Sussex and St. Stephen. A fine month, exceedingly warm and dry in all sections, with temperatures above and rainfall below the average. The continued warm and dry weather caused wells and streams to become dry, and the level of the St. John River was lower than for many years. Light frosts were reported on the 26th, and the foliage of the trees quickly changed colour after this date.

*October.*—Highest temperature 78° on the 6th at Chatham, lowest 18° on the 17th at Sussex. In general, October was exceedingly fine and mild. Heavy rains occurred on the 11th and 25th, otherwise the rainfall was light. Gales occurred on 7th, 10th and 25th, that of the 7th being the heaviest, with a velocity of forty-eight miles from the west. Snow was falling at St. John on the last day of the month. Frosts at night occurred frequently, but in most cases they were light.

*November.*—Highest temperature was 63° on the 7th at Dalhousie, and the lowest 5° on the 28th at St. Stephen. A decidedly dull, unsettled and stormy month, with a marked deficiency of bright sunshine. Frosts occurred almost daily, and after the 23rd quite low temperatures were recorded at night.. Gales from 1st to 7th, 12 to 13th, 15th to 16th, and 21 to 23rd, wind velocity of seventy-two miles an hour was recorded at Lepreaux on the 16th.

*December.*—The highest temperature was 50° at St. John and Moncton, and the lowest 28° at St. Stephen. During the first half of the month wintry conditions prevailed in all sections, and temperatures below zero were frequently recorded, accompanied by high northerly winds. The last decade was mild, with much wet weather and a gradual wasting of the snow covering, which at the close of the month varied from bare ground at St. John to one foot in extreme northern districts. The most important gales occurred on the 2nd, 4th and 7th. Heavy rain fell on the 21st.

## ST. JOHN OBSERVATORY.

WIND DIRECTION AND VELOCITY FOR 1906.

| 1906 | N | | N.E. | | E. | | S.E. | | S. | | S.W. | | W. | | N.W. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MONTHS | Hours | Miles | Hours | Miles | Hours | Miles | Hours | Miles | Hours | Miles | Hours | Miles | Hours | Miles | Hours | Miles | Hours Calm | Total Miles |
| January ....... | 168 | 1,115 | 40 | 381 | 13 | 51 | 31 | 490 | 34 | 458 | 168 | 2,339 | 80 | 837 | 194 | 2,461 | 16 | 8,132 |
| February....... | 77 | 1,056 | 169 | 2666 | 17 | 109 | 43 | 504 | 24 | 166 | 173 | 2,756 | 19 | 111 | 142 | 2,100 | 8 | 9,468 |
| March ......... | 67 | 690 | 52 | 917 | 13 | 135 | 40 | 880 | 35 | 367 | 173 | 2,843 | 13 | 210 | 340 | 6,519 | 11 | 12,561 |
| April . ... ... | 156 | 1,574 | 126 | 1339 | 25 | 200 | 97 | 1455 | 92 | 920 | 137 | 1,440 | 10 | 78 | 71 | 1,016 | 6 | 8,022 |
| May.... ...... | 95 | 1,101 | 86 | 1126 | 22 | 152 | 69 | 754 | 144 | 1,002 | 204 | 2,377 | 18 | 184 | 100 | 1,506 | 6 | 8,202 |
| June..... ..... | 73 | 749 | 104 | 1352 | 55 | 474 | 53 | 304 | 136 | 1,025 | 227 | 2,423 | 21 | 163 | 47 | 769 | 4 | 7,259 |
| July.......... | 33 | 218 | 42 | 281 | 37 | 188 | 73 | 478 | 178 | 1,197 | 334 | 2,860 | 7 | 48 | 27 | 253 | 13 | 5,523 |
| August ........ | 111 | 1,043 | 17 | 97 | 19 | 56 | 190 | 1144 | 210 | 1,618 | 60 | 704 | 46 | 397 | 72 | 944 | 19 | 6,003 |
| September...... | 77 | 799 | 39 | 331 | 4 | 10 | 40 | 318 | 145 | 1,483 | 168 | 2,776 | 35 | 310 | 198 | 3,124 | 14 | 9,151 |
| October.... .. | 73 | 703 | 69 | 695 | 9 | 72 | 115 | 2063 | 149 | 1,464 | 108 | 1,352 | 102 | 1430 | 77 | 870 | 42 | 8,649 |
| November...... | 244 | 4,136 | 115 | 1659 | 19 | 288 | 23 | 334 | 17 | 145 | 21 | 310 | 89 | 864 | 192 | 3,462 | 0 | 11,198 |
| December...... | 280 | 4,148 | 54 | 604 | 54 | 715 | 30 | 646 | 30 | 503 | 45 | 719 | 119 | 972 | 126 | 1,785 | 6 | 10,092 |
| Total for year . | 1454 | 17,332 | 913 | 11448 | 287 | 2450 | 804 | 9370 | 1194 | 10,348 | 1818 | 22,899 | 559 | 5604 | 1586 | 24,809 | 145 | 104,260 |

## ST. JOHN OBSERVATORY.

**Longitude, 45.17° N.** **Longitude, 66.4° W.**

**Meteorological Abstract for 1906.**

| Months | Barometer | | | Thermometer | | | *Cloudiness:* 0 = Clear 10 = Wholly Clouded | *Precipitation:* Rain & Melted Snow | Thunder Storms | Fogs |
|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | Highest | Lowest | Mean | Max. | Min. | | | | |
| January..... | 30.064 | 30.765 | 29.063 | 27. | 49.7 | —0.2 | 5.8 | 4 37 | 0 | 6 |
| February... | 30 127 | 30.972 | 29.165 | 24.8 | 47.3 | —5.6 | 6.5 | 5.15 | 0 | 7 |
| March....... | 29.962 | 30.776 | 28 520 | 26.1 | 46.7 | 0.5 | 5.1 | 6.30 | 0 | 0 |
| April........ | 29 935 | 30.593 | 29.083 | 38.9 | 57.3 | 19.4 | 5.9 | 3.84 | 0 | 1 |
| May ....... | 29.923 | 30.447 | 29 388 | 48.2 | 68. | 36 5 | 6.0 | 7.78 | 0 | 7 |
| June..... .. | 29.913 | 30.176 | 29 508 | 57.1 | 79.2 | 43.2 | 5.6 | 3.81 | 1 | 7 |
| July ........ | 29.978 | 30.454 | 29.629 | 62. | 82. | 50.7 | 6.6 | 2.59 | 2 | 14 |
| August...... | 29 982 | 30.390 | 29 575 | 63.2 | 81.6 | 50.5 | 4.8 | 1.29 | 0 | 10 |
| September... | 30.037 | 30 549 | 29.215 | 56.5 | 75.9 | 39.8 | 4.0 | 1.91 | 0 | 1 |
| October...... | 30.120 | 30.595 | 28.974 | 48.9 | 63.6 | 34.4 | 4 5 | 3.13 | 0 | 6 |
| November .. | 29.899 | 30.149 | 29.377 | 36. | 54.6 | 15.3 | 7.8 | 4.19 | 0 | 8 |
| December ... | 30.036 | 30.824 | 29.199 | 23 5 | 49.8 | —9.3 | 6.3 | 4.54 | 0 | 2 |
| Year... ... | 29.998 | | | 42.6 | | | 5.7 | 48 90 | 3 | 61 |

The total precipitation for the year was 2.84 inches above the average for the past thirty-four years. The mean temperature for the year was 0.8 above the average. The maximum temperature, 82. occurred on the 15th July, and the minimum, —9.3, on the 9th of December. Aurora was observed on August 6th and 13th.

D. LEAVITT HUTCHINSON,
Director,
St. John Observatory.

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